A clinical comparison of polycon and rx-65 gas permeable contact lenses

Jerrold L. Larsen  
Pacific University

Kevin D. Sickel  
Pacific University

Ellen M. Dohr  
Pacific University

Recommended Citation
https://commons.pacificu.edu/opt/620
A clinical comparison of polycon and rx-65 gas permeable contact lenses

Abstract
A comparison of levels of edema induced by Polycon and Rx-56 lens wear was made using pachometric data and slit lamp evaluation. Ten subjects simultaneously wore an Rx-56 lens on one eye and a Polycon lens on the other for a period of three hours. An electronic digital pachometer was used to monitor changes in corneal thickness. No statistical significant difference was found in levels of edema induced by wearing the two brands of lenses.

Degree Type
Thesis

Rights
Terms of use for work posted in CommonKnowledge.

This thesis is available at CommonKnowledge: https://commons.pacificu.edu/opt/620
Copyright and terms of use

If you have downloaded this document directly from the web or from CommonKnowledge, see the “Rights” section on the previous page for the terms of use.

If you have received this document through an interlibrary loan/document delivery service, the following terms of use apply:

Copyright in this work is held by the author(s). You may download or print any portion of this document for personal use only, or for any use that is allowed by fair use (Title 17, §107 U.S.C.). Except for personal or fair use, you or your borrowing library may not reproduce, remix, republish, post, transmit, or distribute this document, or any portion thereof, without the permission of the copyright owner. [Note: If this document is licensed under a Creative Commons license (see “Rights” on the previous page) which allows broader usage rights, your use is governed by the terms of that license.]

Inquiries regarding further use of these materials should be addressed to: CommonKnowledge Rights, Pacific University Library, 2043 College Way, Forest Grove, OR 97116, (503) 352-7209. Email inquiries may be directed to: copyright@pacificu.edu

This thesis is available at CommonKnowledge: https://commons.pacificu.edu/opt/620
A Clinical Comparison of Polycon and RX-56 Gas Permeable Contact Lenses

Jerrold L. Larsen
Kevin D. Sickel
Ellen M. Dohr

Lynn J. Coon, O.D.
Faculty Advisor
Pacific University College of Optometry

April 1982
A Clinical Comparison of Polycon and RX-56 Gas Permeable Contact Lenses

Jerrold L. Larsen
Kevin D. Sickel
Ellen M. Dohr
Lynn J. Coon; Faculty Advisor
April 1982
Pacific University College of Optometry

Midterm Grade A

Final Grade A

Lynn J. Coon
5/4/82
ACKNOWLEDGEMENTS

We wish to express our thanks to our faculty advisor, Dr. Lynn Coon for his advice, counsel, and guidance.

We would also like to thank Ryaco Scientific Corporation for providing complimentary lenses for the subjects in the study.

A special thanks is also extended to the Oregon Optometric Association for assisting us in funding our study.
# TABLE OF CONTENTS

- Abstract ........................................... v
- Introduction ..................................... 1
- Methods .......................................... 2
- Results ........................................... 6
- Discussion ....................................... 7
- Table I ........................................... 10
- Table II .......................................... 11
- Table III ......................................... 12
- Table IV .......................................... 12
- Bibliography .................................... 13
ABSTRACT

A comparison of levels of edema induced by Polycon and Rx-56 lens wear was made using pachometric data and slit lamp evaluation.

Ten subjects simultaneously wore an Rx-56 lens on one eye and a Polycon lens on the other for a period of three hours. An electronic digital pachometer was used to monitor changes in corneal thickness.

No statistical significant difference was found in levels of edema induced by wearing the two brands of lenses.
INTRODUCTION

Oxygen is a necessary requirement for normal corneal metabolic processes. When the eye is open, the majority of oxygen utilized by the cornea is supplied via dissolution in the tears. A contact lens placed upon the eye forms a barrier between the cornea and atmospheric oxygen. To circumvent this obstruction of oxygen, there are two basic methods which may be utilized with rigid contact lenses. These are: (1) a pumping mechanism facilitated by lens rocking and rotation on the eye with blink, and (2) utilization of gas permeable materials. In the past, the pumping mechanism was the only method of oxygen delivery to the cornea with PMMA lenses. The advent of new gas permeable materials gave the practitioner new options. With these lenses, the cornea receives oxygen by diffusion through the gas permeable lens matrix in addition to tear circulation under the lens.

When there is inadequate tear exchange behind a rigid contact lens, the oxygen level between the lens and cornea drops below the minimum level to maintain normal corneal physiology. Water begins to enter the outer corneal layers, increasing corneal thickness and disrupting its normal transparency. This corneal response to lack of oxygen is known as edema. Because it is generally centrally located, rigid lens edema is often called central corneal clouding (CCC). A period of one to three hours is usually necessary before the edema is of sufficient magnitude
that CCC is visible. The CCC first becomes visible when swelling reaches five to seven percent.\textsuperscript{2} In an unadapted rigid contact lens wearer, the lenses increase the lacrimal component of the tears making the tears hypotonic relative to the cornea, which can lead to corneal edema. For this reason, CCC may be noted earlier in an unadapted contact lens wearer.\textsuperscript{3}

The purpose of this study was to make a clinical comparison of corneal thickness changes as a result of wearing RX-56 and Polycon lenses. Measurements of the thickness changes were made with an electronic pachometer and clinically graded utilizing a slit lamp after a three hour period of lens wear. Any significant differences found in corneal thickness changes were to be explained on the basis of the respective contact lens properties and fitting methods.

Gas permeable lenses that are available today give the eye care specialist many options in the management of the edema prone patient. In the last decade it has come to the forefront how important corneal physiology is and how disruptions induced by contact lenses can affect the delicate tissue. It is beneficial to the practitioner to know which type of permeable lens delivers the most oxygen to the cornea.

**METHODS**

The subjects for this study were ten students, eight males and two females, attending Pacific University in Forest Grove, Oregon. All subjects were either non-contact lens wearers or contact lens wearers who had not worn their lenses for at least one year prior to the study. (Previous lens wear was discontinued
for reasons of general discomfort and/or lens intolerance.) The criteria established for subject selection were: (1) absence of current or previous ocular pathology or any obvious ocular or systemic condition that might contraindicate or be aggravated by contact lens wear; (2) age less than 30 years; (3) refractive errors between -1.00 to -6.50 D and absence of any refractive condition that might influence any aspect of fitting; (4) corneal toricity axis 180° (WTR) of 2.00 D or less; and (5) refractive astigmatism of 2.00 D or less.

After baseline data had been established for all subjects, each was fit with RX-56 (porofocon A) and Polycon (silafacon A) contact lenses. All lenses were diagnostic lenses used at Pacific University College of Optometry. The RX-56 lenses were clinically measured and ranged from 9.15 to 9.25 mm in diameter with an average measured optic zone diameter of 8.3 mm and .20 mm center thickness. The Polycon diagnostic lenses were 9.5 mm in diameter with an 8.4 mm optic zone and ranged in center thickness from .075 to .135 mm. Two subjects were fit using Polycon diagnostic lenses 8.5 mm in diameter with a 7.0 mm optic zone and .10 mm center thickness. The smaller Polycon lenses were used in these cases in order to better meet all of the criteria established for proper lens fit.

The initial base curve selection was made on the basis of keratometric measurements. For each lens type, the lens initially selected was that closest to the manufacturer's recommended fitting technique. RX-56 lenses were selected to fit steeper than the flattest corneal meridian by one third the difference between the corneal readings. For patients with less than .75 D of WTR
corneal astigmatism the initial lens chosen was equal to the flattest corneal curvature. Polycon lenses (9.5/8.4) were selected to be flatter than the flattest corneal curvature, the amount depending upon the amount of corneal toricity. For corneal toricity of 0 to 0.75 D, the initial base curve was selected 0.2 to 0.3 mm flatter than the flattest corneal meridian. Eyes with corneal toricity between 1.00 to 1.75 D were initially fit with lenses 0.15 to 0.25 mm flatter than the flattest meridian.

For patients fit with 8.5/7.0 mm Polycon lenses the initial lens selected was that closest to the flattest corneal meridian. Initial positioning of the lenses was observed after tearing subsided.

Biomicroscopy was used to evaluate lens position, movement, and fluorescein pattern. The criteria established for proper lens performance were: (1) positioning of the lens within the palpebral aperture or with the superior edge slightly underneath the upper lid; (2) sufficient lens movement during blinks to insure adequate tear circulation; (3) less than one mm of lag post-blink with the lens remaining centered between blinks; (4) a lens-cornea relationship approaching alignment with no marked seal-off; and (5) absence of significant lens sensation other than that associated with normal lid adaptation. If any of the criteria were not fulfilled with the initial lens recommended by the manufacturer's fitting technique, succeeding base curve selections were made in accordance with standard and accepted fitting methods in order to improve lens fit. The overall diameter was also a variable utilized to attain an optimal fit of Polycon lenses.
After satisfactory lens fits had been established, the next stage of the study was to make pachometric measurements of corneal thickness changes immediately prior to and after three hours of lens wear. Each subject had five central corneal thickness measurements taken immediately prior to lens insertion, establishing a mean, standard deviation, and range for each eye. The instrument used was an Electronic Digital Pachometer Model #6090 marketed by Diagnostic Concepts. Each subject had a Polycon lens placed on one eye and a RX-56 lens placed on the other for a period of three hours. The experiment was run under double blind conditions so neither the subject nor pachometrist knew which lens type was being worn on which eye. After this period, biomicroscopic evaluation using split-limbal technique was made for visible edema. Edema, when observed, was graded on a scale from zero to four: Grade 0 = none; Grade 1 = very light density, no defined borders; Grade 2 = light density, some border definition; Grade 3 = medium density, borders well defined; Grade 4 = dense edema, heavy grey appearance of cornea, localized or general. Pachometric measurements were made immediately after lens removal and the mean, standard deviation, and range computed. The data collected after three hours wear was compared to the pre-wear data in an effort to assess changes in corneal thickness for each eye and each lens. Each subject wore both types of lenses simultaneously thus serving as their own control. Because of this experimental design, differences in corneal thickness between the two eyes were assumed to be primarily due to the characteristics of the two brands of lenses and their
respective fitting methods.

No attempt was made to judge the long term performance of these lenses. Rather, this study dealt with changes in corneal thickness that occurred with the two lens types within the short time period under consideration. Corneal edema (represented as changes in corneal thickness) present after this short wearing time would be prognostic of levels of edema to be manifest during longer periods of wear. Edema due to increased lacrimation in unadapted contact lens wearers would be expected to decrease as lens adaptation occurred.

RESULTS

Changes in corneal thickness as measured pachometrically are shown in Tables I and II for Polycon and RX-56 lenses respectively. The results are expressed in actual measured values and as a percent change of the base-line corneal thickness value. The standard deviation is also presented to give an indication of variability and accuracy of the pachometer and pachometrist. The average corneal thickness changes expressed as a percent change after Polycon and RX-56 lens wear respectively were 3.829 percent and 4.363 percent increase in thickness. These changes when subjected statistically to a difference of means for correlated groups show no significant difference \((t > .05, N = 10)\). The actual \(t\) value obtained was \(-.4519\) with 9 degrees of freedom.

Frequency and severity of corneal edema as detected with a slit lamp is displayed in Table III. As shown, thirteen eyes had no visible signs of edema. Six of the non-edematous eyes
had worn Polycon lenses and the remaining seven had worn RX-56 lenses. Trace amounts of edema were observed in two eyes wearing Polycon lenses and in two eyes wearing RX-56 lenses. Grade one edema was seen in two eyes wearing Polycon lenses and in one eye wearing RX-56.

Staining observed after lens removal was present in only three eyes (see Table IV). Subject number six had variable peripheral staining in each eye which coincided with a relatively large amount of edema induced in each eye by lens wear. Staining observed in subject number one was due to a sharp junction between the base curve and intermediate curve in an RX-56 lens.

DISCUSSION

A clinical and statistical comparison of the amount of edema induced by Polycon and RX-56 lenses shows that there is no significant difference between them. The average corneal thickness increase caused by Polycon wear was slightly less (3.83 percent) than that produced by RX-56 (4.36 percent) but this is not a statistically significant difference.

The results of clinical evaluations of edema as observed with a slit lamp again show no significant difference between the lenses. These results support existing knowledge in the field of contact lenses and corneal physiology in that both the RX-56 and Polycon materials induce much less corneal thickness change than rigid lenses made from polymethylmethacrylate.5, 6, 7, 8

In a recent study at Pacific University, the authors reported an average corneal thickness increase of 7.52 percent in corneas fitted with PMMA.9
In this study, an attempt was made to determine whether a significant difference existed between the two lenses which could be attributed to the lens characteristics. The following is a brief list of the characteristics of the two lenses. The wetting angle for RX-56 \((22^\circ)\) is less than Polycon's \((30.4)^{11}\). A lower wetting angle allows for tears to spread more easily across the surface of the lens. Polycon material has a higher \(\frac{DK}{L}\) \((5.0 \times 10^{-11}\) assuming a center thickness of \(0.10\) mm\) than does RX-56 \((22.5 \times 10^{-11}\) assuming a center thickness of \(0.20\) mm\). A higher \(\frac{DK}{L}\) value allows more oxygen to transmit through the lens material.

Given the results of this study and the above information about oxygen transmission and wettability, it is the opinion of the authors that both lenses perform equally well in vivo in their ability to minimize the induction of corneal edema. However, the results are also in accord with the work by Rich in which he stated that using non-modified lenses (Polycon), edema was observed in 25 percent of the cases, not in 2 percent as the literature states.\(^{14}\) It must also be pointed out that thickness changes measured in this study were within the adaptation period of many individuals and may not be indicative of long term findings.

An issue that should be discussed relative to this study and others before it that utilized the Electronic Digital Pachometer Model \#6090 is the range of variability allowed in the measurements. A deviation of \(\pm 0.0090\) mm has been established as sufficiently accurate in a series of measurements of corneal
thickness. This deviation amounts to a maximum and minimum measurement spanning 3.46 percent of the thickness of an average cornea (.52 mm). For example, the pachometrist could measure a .52 mm thick cornea anywhere from .529 mm down to .511 mm and be within the set standard deviation of the instrument. This range of measurement amounts to 3.46 percent of the thickness of the cornea. This range of variability could be considered acceptable in a clinical setting. However, for a study requiring more precise information where a one percent difference is significant, it is the authors' opinions that the accuracy of the pachometer is not adequate for making conclusive judgements.

Within the last decade, many new contact lens materials have come to the forefront and have expanded the practitioner's avenues to deal with the edema-prone patient. The eye care practitioner must keep abreast of these new materials and understand their benefits and limitations. One cannot however, expect any single material to be ideal for each contact lens candidate. More importantly, every clinician must exercise his/her expertise in fitting lenses such that the optimal lens-cornea relationship be satisfied for every contact lens candidate whether this requires a stock lens or modification.
<table>
<thead>
<tr>
<th>Patient</th>
<th>Baseline Corneal Thickness</th>
<th>Baseline S.D.</th>
<th>Post Wear Corneal Thickness</th>
<th>Post Wear S.D.</th>
<th>Thickness Change</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. MM</td>
<td>.5094</td>
<td>.0070</td>
<td>.5285</td>
<td>.0031</td>
<td>.0191</td>
<td>3.75</td>
</tr>
<tr>
<td>2. GS</td>
<td>.5459</td>
<td>.0087</td>
<td>.5586</td>
<td>.0056</td>
<td>.0127</td>
<td>2.33</td>
</tr>
<tr>
<td>3. SL</td>
<td>.5179</td>
<td>.0064</td>
<td>.5242</td>
<td>.0074</td>
<td>.0263</td>
<td>5.08</td>
</tr>
<tr>
<td>4. RE</td>
<td>.5503</td>
<td>.0065</td>
<td>.5567</td>
<td>.0087</td>
<td>.0064</td>
<td>1.11</td>
</tr>
<tr>
<td>5. GP</td>
<td>.5180</td>
<td>.0034</td>
<td>.5373</td>
<td>.0082</td>
<td>.0193</td>
<td>3.73</td>
</tr>
<tr>
<td>6. CH</td>
<td>.4839</td>
<td>.0086</td>
<td>.5221</td>
<td>.0067</td>
<td>.0387</td>
<td>7.89</td>
</tr>
<tr>
<td>7. NK</td>
<td>.5713</td>
<td>.0059</td>
<td>.6050</td>
<td>.0069</td>
<td>.0337</td>
<td>5.90</td>
</tr>
<tr>
<td>8. SG</td>
<td>.5390</td>
<td>.0063</td>
<td>.5411</td>
<td>.0044</td>
<td>.0021</td>
<td>.39</td>
</tr>
<tr>
<td>9. SM</td>
<td>.5455</td>
<td>.0055</td>
<td>.5420</td>
<td>.0078</td>
<td>-.0035</td>
<td>-.64</td>
</tr>
<tr>
<td>10. JH</td>
<td>.5221</td>
<td>.0071</td>
<td>.5677</td>
<td>.0090</td>
<td>.0456</td>
<td>8.70</td>
</tr>
</tbody>
</table>

Average Thickness Change 3.83%
<table>
<thead>
<tr>
<th>Patient</th>
<th>Baseline</th>
<th>Post Wear</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Corneal Thickness</td>
<td>S.D.</td>
<td>Corneal Thickness</td>
</tr>
<tr>
<td>1. MM</td>
<td>.5248</td>
<td>.0079</td>
<td>.5347</td>
</tr>
<tr>
<td>2. GS</td>
<td>.5163</td>
<td>.0041</td>
<td>.5496</td>
</tr>
<tr>
<td>3. SL</td>
<td>.5242</td>
<td>.0074</td>
<td>.5371</td>
</tr>
<tr>
<td>4. RE</td>
<td>.5545</td>
<td>.0065</td>
<td>.5731</td>
</tr>
<tr>
<td>5. GP</td>
<td>.5104</td>
<td>.0075</td>
<td>.5429</td>
</tr>
<tr>
<td>6. CH</td>
<td>.4917</td>
<td>.0070</td>
<td>.5544</td>
</tr>
<tr>
<td>7. NK</td>
<td>.5618</td>
<td>.0068</td>
<td>.5808</td>
</tr>
<tr>
<td>8. JG</td>
<td>.5424</td>
<td>.0087</td>
<td>.5583</td>
</tr>
<tr>
<td>9. SM</td>
<td>.5515</td>
<td>.0626</td>
<td>.5634</td>
</tr>
<tr>
<td>10. JH</td>
<td>.5204</td>
<td>.0081</td>
<td>.5305</td>
</tr>
</tbody>
</table>

Average Thickness Change 4.36%
### Table III
**Incidence of Corneal Edema After 3 Hours of Lens Wear**

<table>
<thead>
<tr>
<th>Lens</th>
<th>Degree of Edema</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative</td>
</tr>
<tr>
<td>Polycon</td>
<td>6</td>
</tr>
<tr>
<td>RX-56</td>
<td>7</td>
</tr>
</tbody>
</table>

### Table IV
**Frequency of Corneal Staining**

<table>
<thead>
<tr>
<th>Lens</th>
<th>Grade 0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polycon</td>
<td>9</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>RX-56</td>
<td>8</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Bibliography


3. Ibid.

4. Handout furnished by Kerns, R., Pacific University College of Optometry, Contact lens cover.


11. Reported wetting angle by Syntex Ophthalmics.

12. Reported DK/L value by Syntex Ophthalmics.

13. Reported DK/L value by Rynco Scientific Corporation.
