A comparative study on two aspheric lenses: Biomedic 55 aspheric and frequency 55 aspheric

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A comparative study on two aspheric lenses: Biomedic 55 aspheric and frequency 55 aspheric

Abstract
Background: It has been suggested that aspheric contact lenses may provide better visual performance than conventional spherical soft contact lenses. Previous studies conducted on Aspheric lenses found that they may be masking some astigmatism resulting in better vision. However, other studies have not supported this finding and instead found that Aspheric lenses may mask spherical aberration, providing better vision. In this study we compare the visual performance of two Aspheric lenses: Frequency 55 Aspheric and Biomedic Premium, to determine whether visual performance differs between them.

Methods: This study was a randomized, double blind in which the subjects wore two different aspheric lenses Cooper Vision Frequency 55 Aspheric and Biomedic Aspheric Premium for at least eight hours. We recruited seventeen optometry students from Pacific University who were current soft contact lens wearers. For both lenses, high and low contrast visual acuity were taken with their natural pupil size, subjective quality of vision was assessed with a questionnaire, and high contrast visual acuity was measured while the patient was dilated through a 3mm and a 6mm aperture to control pupil size.

Results: Objectively we found that there are no differences in visual performance between the two lenses. Subjectively, we found that patients preferred the vision of Biomedic Premium lenses over Frequency 55 Aspheric.

Conclusions: What ultimately will dictate which lens the patient will wear is based on patient comfort and fit. Based on our study Biomedics was subjectively preferred over the Frequency 55 Aspheric.

Degree Type
Thesis

Degree Name
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Committee Chair
Beth Kinoshita

Keywords
aspheric, soft contact lenses, visual performance, astigmatism, spherical aberration

Subject Categories
Optometry
A COMPARATIVE STUDY ON TWO ASPHERIC LENSES:
BIOMEDIC 55 ASPHERIC AND FREQUENCY 55 ASPHERIC

By: LORINA LEUNG
EVA SO

A thesis submitted to the faculty of the
College of Optometry
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BIOGRAPHIES

Eva So completed her undergraduate degree in biology at the University of British Columbia and will complete her Doctorate of Optometry degree at Pacific University with distinction in 2007. She was awarded an entrance scholarship from Pacific University in 2003. Following graduation, Eva plans to complete her residency in ocular disease and then will return to Vancouver, BC to serve her hometown. Her passions include outdoor activities such as hiking, swimming and in-line skating.

Lorina Leung received her bachelor degree in psychology with a biology emphasis at the University of California at Davis. She will complete her Doctorate of Optometry at Pacific University in 2007. Following graduation, Lorina look will search for a full time career in a private practice around the Bay area in California. Her hobbies include biking, tennis, and any outdoor activities.
ABSTRACT:

Background: It has been suggested that aspheric contact lenses may provide better visual performance than conventional spherical soft contact lenses. Previous studies conducted on Aspheric lenses found that they may be masking some astigmatism resulting in better vision. However, other studies have not supported this finding and instead found that Aspheric lenses may mask spherical aberration, providing better vision. In this study we compare the visual performance of two Aspheric lenses: Frequency 55 Aspheric and Biomedic Premium, to determine whether visual performance differs between them.

Methods: This study was a randomized, double blind in which the subjects wore two different aspheric lenses Cooper Vision Frequency 55 Aspheric and Biomedic Aspheric Premium for at least eight hours. We recruited seventeen optometry students from Pacific University who were current soft contact lens wearers. For both lenses, high and low contrast visual acuity were taken with their natural pupil size, subjective quality of vision was assessed with a questionnaire, and high contrast visual acuity was measured while the patient was dilated through a 3mm and a 6mm aperture to control pupil size. Results: Objectively we found that there are no differences in visual performance between the two lenses. Subjectively, we found that patients preferred the vision of Biomedic Premium lenses over Frequency 55 Aspheric. Conclusions: What ultimately will dictate which lens the patient will wear is based on patient comfort and fit. Based on our study, Biomedics was subjectively preferred over the Frequency 55 Aspheric.

Key words: Aspheric, soft contact lenses, visual performance, astigmatism, spherical aberration
Without the help of several faculty members at Pacific University, College of Optometry we would not have been able to put this thesis together. Thanks to Dr. Jennifer Smythe for the idea of the thesis project during our contact lens course. Thanks to Pat Caroline who spent countless hours designing the thesis project and providing several revisions for the paper of this thesis project. We are especially appreciative of Dr. Peter Bergenske for helping us make the pinhole apertures for our thesis project, designing our thesis project, helping us with several revisions of the paper, and also providing the statistical analysis for our data. Finally, we are truly grateful for Dr. Beth Kinoshita for helping us with the final revisions of the thesis project and providing us with many helpful suggestions to develop the final draft that we have.
A comparative study on two Aspheric Lenses: Biomedic 55 Aspheric and Frequency 55 Aspheric

It has been suggested that aspheric contact lenses may provide better visual performance than conventional spherical soft contact lenses. From the study done by Nimesh et al. (2004) they compared Frequency 55 Sphere with Frequency 55 Aspheric lenses and found that aspheric lenses mask (was stated in Morgan's study on page 43) more astigmatism in ATR and oblique astigmatism. Aspherics were noted to provide better acuity by half a line than spherical lenses. Researchers in this study felt that the design of the aspherical lens played a large part in masking the astigmatism. Another study conducted by Brazeau et al. (1994) found that patients with low astigmatism showed better visual performance at higher spatial frequencies and provided better visual acuity with aspheric SV-38 lenses than Optoflex spherical lenses and spectacles. They found that SV-38 contact lens provided better optical quality by reducing spherical aberration. In Morgan et al.'s study, it is suggested that aspheric soft lenses cannot correct for astigmatism but may provide a small amount of improved visual acuity because of its ability to reduce spherical aberration.

A spherical surface lens may produce a blurred image because peripheral light rays do not focus to a point causing spherical aberration. By changing the lens shape into an aspheric curve, it should theoretically minimize spherical aberration by bringing the rays to a focus, resulting in a reduced blur circle which provides a sharper image.

Currently there are three different brands of soft contact lenses that are designed for reducing aberrations; not including aspheric soft contact lens designs as bifocal lenses. The three types of Aspheric soft contact lenses in the market are Biomedic 55 Aspheric, Frequency 55 Aspheric, and BioCurve Advanced Aspheric Design. With these different options, a practitioner must decide which lens will provide the best visual quality for the majority of patients. Recent literature review has revealed that there are no reported studies to show better visual acuity and function in one type of aspheric lens compared to another. In our study we compared the visual acuity and function of two types of aspheric lenses, Frequency 55 Aspheric versus Biomedic 55 Aspheric.
Spherical contact lens optics
Traditionally the anterior and posterior surfaces of soft contact lenses are spherical. The power is constant throughout the lens so distance objects are refracted at a sharper angle the further away from the center. Thus, central and peripheral light rays are not focused to a single point (Caroline 2004).

Aspherical contact lens optics
Anterior aspheric optics correct spherical aberration by effective power changes throughout the optical portion of the lens. A greater number of peripheral rays are focused on to the retina.

Large pupil size causes more spherical aberrations which results in decreased acuities (Caroline 2004). With aspheric lenses, people with large pupil sizes gain improvement in acuity as shown in Charman 2002. Morgan et al (2005) compared aspheric soft contact lenses with spectacles and toric soft contact lenses using high and low contrast charts using 2mm, 4mm, and 6mm pupil sizes. They found that high contrast acuity was poorer
with aspheric lenses versus toric soft contact lens and spectacle correction for large pupils (e.g. 4mm and 6mm) but acuity was the same for aspheric and spectacle correction for a 2mm pupil size. Low contrast acuity was poorer with Aspheric in a 6mm pupil than a smaller pupil compared to spectacle and toric soft contact lens correction. Because of the variable affects of pupil size on acuity, we held pupil size constant with the use of a 3mm and 6mm aperture in our study.

In a study by Vaz & Gundel 2003, they found no statistically significant difference between spherical and aspherical lenses with low and high contrast acuity testing. Although there were no objective acuity improvements with aspheric lenses, subjects at a ratio of 2:1 preferred aspheric designs over spherical lenses. There are clinical implications of fitting patients to provide the best subjective and objective visual quality. Therefore, both objective and subjective findings are important in determining the best lens for patients.

**Methods**

The research involved in this study followed the tenets of the Declaration of Helsinki. Informed consent was obtained from the subjects after explanation of the nature and possible consequences of the study and the research was approved by the IRB. This study was a randomized, double blind in which the subjects wore two different aspheric lenses Cooper Vision Frequency 55 Aspheric and Biomedic Aspheric Premium for at least eight hours. Please see Table 1 for lens detail.

**Table 1:**

<table>
<thead>
<tr>
<th>Manufacturing Material</th>
<th>Water content</th>
<th>dK Value</th>
<th>UV Inhibitor</th>
<th>Replacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooper Vision Freq 55 Aspheric</td>
<td>Methafilcon A</td>
<td>55.0%</td>
<td>18.8</td>
<td>None</td>
</tr>
<tr>
<td>Biomedic Aspheric Premium</td>
<td>Ocufilcon F</td>
<td>60.0%</td>
<td>34.0</td>
<td>yes</td>
</tr>
</tbody>
</table>

**Table 1a:**

<table>
<thead>
<tr>
<th>Power</th>
<th>Base Curve</th>
<th>Diameter</th>
<th>Optic Zone</th>
<th>Center Thickness</th>
<th>Visibility tint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooper Vision Freq 55 Aspheric</td>
<td>+8.00 to -10.00</td>
<td>8.7, 8.4</td>
<td>14.4</td>
<td>8.0mm</td>
<td>0.09mm</td>
</tr>
<tr>
<td>Biomedic Aspheric Premium</td>
<td>(+6.00) to -6.00 (-10.00)</td>
<td>std</td>
<td>13.1</td>
<td>unknown</td>
<td>0.08mm</td>
</tr>
</tbody>
</table>

We recruited optometry students from Pacific University who are current soft contact lens wearers. To qualify for the study all subjects had to meet inclusion and exclusion criteria outlined below.
Inclusion criteria:
• Subjects must be current successful soft contact lens wearers with naturally occurring refractive myopia (near sightedness) from -0.25 D to -12.00 D or hyperopia (far-sightedness) from +0.25 D to +6.00 D sphere (spectacle plane), with 1.00 D or less of refractive astigmatism (spectacle plane), as determined by vision examination.
• Subjects must have a best spectacle corrected high contrast visual acuity of at least 20/20 in each eye.
All subjects must be able to wear contact lenses in both eyes and willing and capable to return for all scheduled visits for a period of at least two days (not necessarily consecutively) to participate in both phases of the study.

Exclusion criteria:
• Any subject in which their refractive error does not fall within: -0.25 D to -12.00 D or +0.25 D to +6.00 D sphere (spectacle plane), with 1.00 D or less of refractive astigmatism.
• Female subjects who are pregnant, breast-feeding or intend to become pregnant over the course of the study.
• Subjects with a history of any of the following medical conditions: collagen vascular disease, autoimmune disease, immunodeficiency diseases, ocular herpes zoster or simplex, endocrine disorders (including, but not limited to active thyroid disorders and diabetes, lupus, and rheumatoid arthritis).
• Subjects with a history of intraocular or corneal surgery (including cataract extraction and refractive corneal surgery)
• Subjects with active ophthalmic disease or abnormality (including, but not limited to, blepharitis, recurrent corneal erosion, dry eye syndrome, neovascularization (new growth of blood vessels on the front surface of the eye > 1mm from limbus), clinically significant lens opacity, clinical evidence of trauma (including corneal scarring), or with evidence of glaucoma (high eye pressure) or propensity for narrow angle glaucoma as determined by Van Herrick evaluation with slit lamp examination of both eyes.
• Subjects with evidence of keratoconus (steepening of the front surface of their eye), corneal irregularity, or abnormal videokeratography in either eye.
• Subjects who are participating in any other clinical trial (FDA or other).
• Subjects who are allergic or have any adverse reactions to 1% tropicamide and 2.5% phenylephrine (drugs used to dilate the pupil (opens up the central dark area of the eye)).
• Subjects who are currently wearing rigid contact lenses.

Seventeen subjects, ten females and seven males with the average age of 23.4 years old were recruited and all completed the study. Both eyes of all seventeen subjects were fitted with the contact lenses. Average horizontal visible iris of all subjects was 11.50 millimeters and range from 10.86mm to 12.30mm. Refractive error of the subjects ranged from -0.75D to -8.00D. Average refractive error using equivalent sphere was -3.69D. Three subjects had astigmatism which ranged from -0.50D to -1.25D. Subjects were informed about the risk of complications associated with normal contact lens wear and side effects of dilation.
**Initial Examination:**
We took high contrast visual acuity measurement with the subject’s habitual correction, spectacles or contact lenses, using a LogMar Chart produced by UC Berkeley College of Optometry. Slit lamp examination was done to rule out any underlying eye diseases. Each subject was randomly assigned to either the Cooper Vision Frequency 55 Aspheric or Biomedics Aspheric Premium Lens group. Corneal mapping was measured with the Medmont Corneal Topographer (Medmont International Pty. Ltd.). With this information we diagnostically fit our subjects into one of the two contact lens groups. We performed a spherical over-refraction to achieve binocular balance and best Snellen visual acuity based on over-refraction. Contact lens fit was evaluated based on coverage, centration, and movement. All subjects had acceptable fits with both lens based on these criteria. Subjects were instructed to wear lenses for at least eight hours before the next visit. They were instructed to maintain lenses with their habitual lens care system as outlined in their lens cleaning package inserts.

**Follow Up Examination:**
When subjects returned for their follow up visit after wearing the lenses for at least eight hours, high and low contrast visual acuity was taken with their natural pupil size under standard room illumination. Subjects were then diagnostically fit with the second pair of study lenses. Slit lamp exam was then conducted to evaluate lens position and movement. The subject was asked to remove the contact lenses and pupils were dilated with 1 drop of 1% tropicamide and 1 drop of 2.5% phenylephrine in each eye. While dilating, subjects reinserted their first pair of lenses and filled out a questionnaire (Appendix 1) assessing their quality of vision while using the computer, reading and writing, in low light setting while looking in the distance, day time lighting while looking in the distance, and vision overall with their first pair of lenses.

We waited 15 minutes for the drops to take effect. Then the dilated subjects high contrast visual acuity was measured by a masked examiner with a 3mm and a 6mm aperture. Subjects were instructed to wear their second pair of lenses for at least eight hours before the next visit.

**Second Follow Up Exam:**
When subjects returned for their second follow up after wearing lenses for at least eight hours of lens wear, the patient underwent the follow-up testing procedures similar to the first follow-up examination. High contrast visual acuity was assessed with their natural pupil size by a masked examiner. Subjects were then instructed to remove the contact lenses and their pupils were dilated with 1 drop of 1% tropicamide and 1 drop of 2.5% phenylephrine in each eye. While dilating, subjects reinserted their lenses and filled out the same questionnaire about their quality of vision to the second pair of lenses. Subject’s high contrast visual acuity was then measured with their dilated pupils with a 3mm and a 6mm aperture by a masked examiner.

To reduce the likelihood of memorization, two different LogMar charts were randomly interchanged.
Materials:
To maintain constant pupil size, we used two fabricated apertures, of three millimeters and six millimeters in diameter by boring a hole in the center of two trial lens occluders. These lens occluders were placed in a trial frame which was positioned so that the center of each subject's pupil aligned with the center of the aperture. Subjects were dilated such that their pupil size was larger than our six millimeter aperture.

Results
We evaluated the visual performance of two aspheric lenses by measuring acuities through 3mm and 6mm pupils with a high contrast logMar chart. We found that acuities were better through 3mm pupils than 6mm pupils in both lenses. Using the analysis of variance with the Bonferroni Multiple Comparison Test we found the p value to be less than 0.05. There was no significant difference in vision between Freq 55 Aspheric and Biomedic Premium Aspheric when comparing 3mm to 3mm pupils and 6mm to 6mm pupils while wearing either lens.

None of the pairs of subjective scores were significantly different using Friedman repeated measures ANOVA and Dunn's multiple comparison test. However, when comparing the ranked scores for each of the categories (see categories in table 2), the biomedic scores are significantly higher (p=0.0062, paired t test of t=5.266, df=4). The sum of the ranked scores for the biomedics were higher in general.

Cylinder, Astigmatism
According to Kerns RL 1974 and Patel et. al 2004, aspheric lenses can improve the vision in low cylinder patients (-0.50 to -1.75). Our study did not specifically test for how astigmatism would have affected vision with aspheric lenses. In addition most of our subjects did not have significant astigmatism, however several subjects with small amounts of astigmatism (-0.25 to -1.00) noted that their vision was clearer when their astigmatism was corrected in their spectacles. This subjective finding helps to support that aspherical lenses do not correct for small amounts of astigmatism since subjects did not feel their vision was as sharp compared to when they wore their glasses.

Conclusions
Two aspheric lenses, Frequency 55 Aspheric and Biomedic Premium have been found to provide equal quality of vision with objective testing. What ultimately will dictate which lens the patient will wear is based on patient comfort and fit. Patients in our study preferred Biomedic lenses in all categories of our questionnaire. Therefore, although there was no objective difference found in high contrast acuities between the lenses at equal aperture sizes, it appears the subjective response to the Biomedics was preferred over the Frequency 55 Aspheric.
Large pupil size adversely affected vision regardless of whether subjects wore Freq 55 Aspheric and Biomedic Premium lenses. Larger pupil size causes more spherical aberration and decreases depth of focus which adversely affects visual acuity. This is consistent with Morgan et al.'s 2005 study which found that 4mm and 6mm pupil size acuities had decreased acuities of at least a half line over the 2mm pupil.
Upon further evaluation, we could have obtained greater significant difference with our objective findings if we had our subjects tested with low contrast acuity charts or in different light settings. We tested visual performance with high contrast log Mar charts and found no significant difference between the two aspheric lenses. With further low contrast visual acuity testing, we may also find further preferences between the two aspheric lenses. If our study analyzed comfort during the day and extended the wear of each lens, perhaps we would have also found other significant differences in subjective preference.
References:


Subject Lens Satisfaction Questionnaire

For each of the following questions please circle on the scale your response:

1. How satisfied were you with your vision while using the computer?

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<tr>
<th>1</th>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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<tbody>
<tr>
<td>Totally unsatisfied</td>
<td></td>
<td></td>
<td></td>
<td>Neutral</td>
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<td>Totally satisfied</td>
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2. How satisfied were you with your vision while reading and writing?

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3. How satisfied were you with your vision while in low light setting looking into the distance?

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<td></td>
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4. How satisfied were you with your vision while in day time lighting looking into the distance?

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5. How satisfied were you with your vision overall?

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