A Study of Residual Astigmatism and Flexure in Fluoroperm 151 lenses Fit 0.50 D Flatter Than “K” On With-The-Rule Toric Corneas.

Matthew J. Martin

Candidate for Doctor of Optometry Class 1999.

Abstract

In recent years the RGP lens market has seen a dramatic increase in the introduction of higher DK materials. These higher DK materials allow for greater oxygen permeability for a given thickness (DK/L) of material. The recent trend in RGP manufacture has been to produce lenses with the maximum DK available. The new materials used to create these RGP lenses can experience a number of lens performance issues such as wettability, dimensional stability, specific gravity, and excessive flexure. This study addresses flexure and residual astigmatism in patients fit with Flouroperm 151 RGP lenses.

Introduction

Rigid Gas Permeable Contact Lenses (RGPs) have been an integral part of the contact lens market for many years. RGP lens materials have gone through many different permutations. One of the driving reasons for this change of materials has been the need to increase the oxygen permeability. Oxygen permeability (DK) is independent of the thickness, shape or condition of the lens [1]. Oxygen permeability (DK) divided by the thickness of the material (L) gives an indication of the material's ability to transmit oxygen. Oxygen transmission is essential for the physiological health of the cornea [1]. Materials have progressed from (polymethylmethacrylate) PMMA lenses, which had essentially no oxygen permeability, to newer materials having in excess of 90DK. One of the new materials that demonstrate the trend in higher DK materials is the Flouroperm 151. The Fluoroperm 151 is produced by Paragon Vision Sciences and has a DK of 151 (2). The Fluoroperm 151 is made of Paflufocon D and is approved for seven-day continuous ware.

It has been shown by Harris *et al.* [3,4,5] as well as many others [7], that varying RGP design with regard to center thickness and base curve relationship can effect the amount of flexure produced by a given lens. It has also been shown that differences exist in flexure between various materials when lens parameters and fitting relationships are held constant [5,6]. This study was designed to evaluate the flexure and residual astigmatism on toric corneas using 9.3-mm diameter Fluoroperm 150 lenses fit 0.50D flatter than K.

Methods

Four subjects (five eyes) were selected for the purposes of the study. Two of the subjects had previous experience with wearing contact lenses, but none of the subjects had worn RGP lenses previously. Each subject was given a brief vision examination including refraction, topography, slit lamp examination, and keratometric readings. All of the subjects had with-the-rule toric corneas, and four of the five eyes had with-the-rule residual astigmatism as summarized in Fig. #1.

The lenses used in this study were Paragon Vision Sciences Fluoroperm 151 lenses in the following parameters: 9.3mm diameter, 8.10 optic zone, -3.00D power, .15 center thickness. The only parameter changed in each lens was the Base Curve, which varied between 7.70mm and 7.80mm Each subject was refracted to determine BVA and optimal correction. The subjects' corneal curvature was then measured topographically using Humphrey Instruments ATLAS Version A6, and traditional keratometric readings. An external ocular health examination was also briefly performed to determine candidacy for the trial. Each subject was then fit 0.50D flatter than K as determined by topographic keratometry readings. After a five minute lens stabilization period, spherocylinder overefraction to BVA was performed to determine residual astigmatism. Each lens was then measured using topographic and traditional keratometry readings to determine flexure of the lens in vivo.

Results

Calculated Residual astigmatism based on topographic keratometery readings, using the formula spectacle cylindrical correction minus corneal toricity for each eye, are as follows:

1. 41.50@09041.00@180 ΔK= -0.50X180
   Spectacle Rx: -3.75
   RA = 0.00 - (-0.50X180)
   RA = -0.50X090

2. 43.25@06442.25@154 ΔK= -1.00X154
   Spectacle RX: PL -0.50X135
   RA = -0.50X135 - 1.00X154
   RA = -0.50X045

3. 46.12@08845.12@178 ΔK= -1.00X178
   Spectacle RX: PL -0.50X105
   RA = -0.50X105 - (+1.00X105)
   RA = -150X105

4. 45.75@09044.25@180 ΔK= -1.50X180
   Spectacle RX: -1.00 -0.25X150
   RA = -0.25X150 -(-1.50X180)
   RA = +1.25X180 or -1.25X090

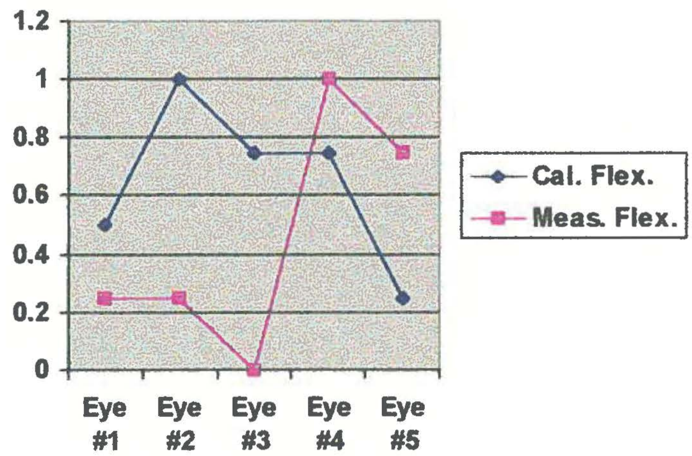
5. 43.75@124 43.00@034 ΔK= -0.75X034
   Spectacle RX: -0.75 -0.50X034
   RA = -0.50X034 -(-0.75X034)
   RA = +0.25X034 or -0.25X124

Measured flexure calculated from over refraction, and residual astigmatism, compared to flexure as measured by topographic keratometry, are as follows:
Fig. #1.

Eye #	Cal. RA	CYL via O.R.	Cal. Flexure	Measured Flexure	ΔF
Eye #1	-0.50X090	none	+0.50X090	+0.25X090	0.25
Eye #2	-0.50X045	+0.50X055	+1.00X055	+0.25X055	0.75
Eye #3	-1.50X105	-0.75X105	+0.75X015	none	0.75
Eye #4	-1.25X090	-0.50X090	+0.75X090	+1.00X180	1.75
Eye #5	-0.25X124	-0.50X135	+0.25X045	+0.75X180	NA
Mean	-0.800	-0.250	0.650	0.450	0.700
Median	-0.500	-0.500	0.750	0.250	0.750
Std Dev.	0.542	0.500	0.285	0.411	0.671
Range	-1.500 –0.250	-0.750 – 0.500	0.250 – 1.00	0.00 – 1.00	0.00 – 1.75

Correlation of calculated flexure and measured flexure: -0.320, P-Value = 0.599.

Fig. #2. Demonstrates the variability between calculated flexure, and measured flexure in all five eyes.



Conclusions

The results of this study appear to indicate that Flouroperm 151 lenses, made with Paflufocon D and fit 0.50 Diopter steeper than K, on with-the-rule-toric corneas, flex from +0.00D to +1.00D with a mean of +0.450 and a std. dev. of 0.411. Comparing measured flexure to calculated flexure (Fig. #1), results in a poor correlation (-0.320), indicating that the amount of predicted flexure does not necessarily predict the amount of flexure as measured. The difference between calculated flexure and measured flexure ΔF is of importance when considering the flexure inherent in a given material. With respect to this study, ΔF (the difference between predicted and measured flexure) revealed a range of 0.00–1.75 with a mean of 0.450 and a std. dev. of 0.671. The large range and high std. dev. of the ΔF figures do not allow for accurate conclusions to be drawn from this data set. ΔF can exist due to variability in the material, the design of the lens/fitting relationship, the design of the contact lens itself, and error inherent in the measurements used to calculate the ΔK figures. Due to the variability of the data and the reduced sample size, few if any conclusions can be drawn from this study. The results achieved however appear to indicate the need for future research directed toward the flexure inherent in today's higher Dk materials.

Future studies designed to measure flexure in high DK materials should include a sample size of at least 10 eyes. The sample should include several eyes of approximately the same toricity and axis. Also, limiting toricity to with the rule-toric-corneas ± 10° would assist in decreasing the effect of lid position as it relates to residual astigmatism. Furthermore, patients whose measurements of spectacle RX and corneal toricity differ more than 10° (with regard to axis of astigmatism) should be eliminated from the results due to a cross-cylinder situation which can impact the outcome of the calculated results.

References

1. Bennet Edward S. and Henry Vinita Allee: *Clinical manual of Contact Lenses*. J.B. Lippincott Company. Philidelphia, USA 1994.
2. Thompson, Tyler: *Tylers Quartely Soft Contact Lens Parameter Guide, March 1998*. Tylers Quarterly INC Arkansas. USA.
3. Harris, Michael G. et al. *The Effect of Contact Lens Thickness and Corneal Toricity on Flexure and Residual Astigmatism*, American Journal of Optometry and Archives of American Academy of Optometry, April 1972 pp304-307.
4. Harris, Michael G. et al. *Lens Flexure and Residual Astigmatism with Polycon and Polymethyl Methacrylate Lenses on Toric Corneas*. American Journal of Optometry and Physiological Optics. March 1982, Vol. 59, no3, pp263-266.
5. Harris et al. *Flexure and Residual Astigmatism with Cellulose Buterate (CAB) Contact Lenses on Toric Corneas*. American Journal of Optometry and Physiological Optics Feb. 8 1981, Vol. 59, pp 858-862.
6. Herman, John P. *Flexure of Rigid Contact Lenses on Toric Corneas as a fuction of Base Curve and Fitting Relationship*. Journal of the American Optometric Association. March 1983, Vol. 54, No.3, pp209-213.
7. Pole, John J. *The Effect of the Base Curve on the Flexure of Polycon Lenses*. International Contact Lens Clinic. Jan. 1983,Vol. 10, No.1.pp49-51.