THE ACCURACY OF SIMULATED FLUORESCEIN PATTERNS PRODUCED BY MEDMONT STUDIO WITH A MEDMONT CORENAL TOPOPGRAPHER IN COMPARISON TO ACTUAL FLUORSCEIN PATTERNS OBSERVED WITH GAS PERMEABLE LENSES OF IDENTICAL PARAMETERS

by

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ABSTRACT

Background: Medmont Studio software has a feature that can predict the fluorescein pattern of a gas permeable contact lens using a patient's topography. It has been proposed by Medmont that lenses can be ordered empirically by using the projected fluorescein pattern instead of using a diagnostic lens. *Methods:* Twenty eyes were fit in one of eight gas permeable lenses and the fluorescein pattern was photographed using an anterior segment camera. The actual fluorescein pattern was then compared to the projected fluorescein pattern of the lens on the patient's cornea using the Medmont software. *Results:* In eighteen out of twenty eyes, Medmont software accurately predicted the actual fluorescein pattern. In the two eyes that the predicted and actual fluorescein patterns did not coincide, smaller than average horizontal visible iris diameter played a role. *Conclusions:* Medmont Studio software is able to accurately predict fluorescein patterns on eyes with average parameters. For most eyes, Medmont Studio software is a viable option for empirically ordering gas permeable lenses. The software may significantly decrease the number of diagnostic lenses tried before a successful fit is achieved and significantly decrease chair time for the optometrist.

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Introduction

In recent years, soft contact lens fittings have outnumbered gas permeable fits. This is likely due to the perception that fitting gas permeable lenses is more complicated and time-consuming. It is unfortunate that this method of vision correction is underutilized, as it offers many benefits over soft contact lenses. Because gas permeable lenses are more rigid that soft lenses, the lens is able to maintain its shape even during the blink which results in enhanced optical clarity. Gas permeable lenses also provide more oxygen permeability over traditional soft contact lenses. Better surface wettability results less protein and lipid deposition on gas permeable lenses. Because gas permeable lenses do not need to be replaced as often, they provide a lower cost alternative to soft lenses, as well as a more durable option. Some patients may find gas permeable lenses easier to insert because of the smaller size. Additionally, the role of gas permeable lenses in slowing myopia progression is an exciting concept.

Assessing corneal curvature is an important part of achieving a successful contact lens fit. However, other corneal characteristics, such as corneal diameter and corneal asphericity, must be taken into account. In recent years, videokeratography has become a popular method to assess these corneal parameters when fitting gas permeable lenses.

Medmont E300 Corneal Topographer is an example of a videokeratographer that uses Placido rings to provide a detailed map of the corneal surface. Medmont E300 may be used in conjunction with Medmont Studio software to predict the fluorescein pattern of a gas permeable contact lens using a patient's topography. It has been proposed by Medmont that lenses can be ordered empirically by using the projected fluorescein pattern instead of using a diagnostic lens. The purpose of this study is to evaluate the accuracy of the Medmont software in predicting fluorescein patterns. Medmont Studio may simplify the process of gas permeable lens fitting by significantly decreasing the number of diagnostic lenses needed to achieve a successful fit. Technology such as this could be exciting for the future of gas permeable lenses, as it could simplify lens fitting for the practitioner and allow more patients to experience the benefits gas permeable lenses have to offer.

Methods

Six female and four male optometry students from Michigan College of Optometry volunteered for the study. Subjects were between 22 and 27 years old. One of the students had a 10 mm horizontal visible iris diameter (HVID), which is considerably smaller than average. One of the students was post-surgical photorefractive keratectomy (PRK). Simulated keratometry values acquired with the Medmont topographer ranged from 47.94 diopters (7.04 millimeters) to 37.92 diopters (8.9 millimeters), and corneal cylinder power ranged from 0.12 diopters to 3.11 diopters. Data was gathered by a single investigator to ensure consistency.

Eight tri-curve lenses of different base curves and diameters were used in the study (Table 1). The investigator first obtained the corneal topography of each patient. Next, one of the eight lenses in Table 1 was selected at random to place on the patient's eye. The selected lens's base curve, peripheral curve, and diameter were entered into Medmont Studio's standard tri-curve setting on the software, and a simulated fluorescein pattern was calculated according to the patient's topography. A drop of proparacaine was instilled into the patient's eye to reduce tearing and improve the reliability of the fluorescein pattern. The lens was then placed on the eye, fluorescein was instilled, and the fluorescein pattern was photographed using a slit-lamp mounted anterior segment camera.

Table 1. Lenses Used in Study (all basic Tri-curve design)

	Base Curve	2^ curve	3^ curve	Diameter	Lens Power
Lens #1	7.2 mm	8.7	10.2	8.5mm	-3.50
Lens #2	7.4 mm	8.9	10.4	9.4mm	-3.00
Lens #3	7.5 mm	9.0	10.5	9.0mm	-4.25
Lens #4	7.7 mm	9.2	10.7	9.4mm	-3.00
Lens #5	7.9 mm	9.4	10.9	9.4mm	-0.50
Lens #6	8.0 mm	9.5	11.0	8.5mm	-3.00
Lens #7	8.1 mm	9.6	11.1	9.4mm	-0.50
Lens #8	8.3 mm	9.8	11.3	9.5mm	-3.00

Results

Projected vs actual fluorescein patterns are shown in Appendix A, as well as a brief interpretation of the results.

Discussion

This study found that the Medmont E300 Corneal Topographer in conjunction with Medmont Studio software was able to successfully predict the fluorescein pattern in eyes with average corneal parameters. In eighteen out of twenty eyes, Medmont software accurately predicted the actual fluorescein pattern. In the two eyes that the predicted and actual fluorescein patterns did not coincide, smaller than average horizontal visible iris diameter played a role. This finding supports other studies that point to the underestimated importance of corneal diameter when fitting lenses[2].

The importance of horizontal visible iris diameter in the fitting of lenses can be explained by its effect on saggital depth. Gas permeable lenses are fit by aligning the sagittal depth of the lens with that of the cornea. Saggital depth is dependent upon, in order of importance, corneal diameter, eccentricity, and central curvature[2]. The larger the corneal diameter the greater the sagittal depth; the lower the corneal eccentricity the greater the sag; and the steeper the central radius of curvature the greater the sag. The Medmont topographer obtains corneal eccentricity and curvature, but it is up to the practitioner to acquire the corneal diameter measurement. Fortunately, horizontal visible iris diameter is measured easily in the clinic.

The practitioner should realize that if the measurement falls outside of the normal 11.5-12 millimeters[4], Medmont Studio fluorescein simulation will not be accurate. Studies have found that horizontal visible iris diameter quickly approaches its adult measurement within the first months of birth, so it is reasonable to assume that Medmont Studio software would be successful in predicting fluorescein patterns in children[1]. Although this study did not include any very large corneas, it is to be expected that, similar to small corneas, actual and predicted fluorescein patterns would not coincide.

Corneal eccentricity is also important in fitting contact lenses. Eccentricity describes how quickly the cornea flattens in the periphery. Most corneas have an eccentricity value of 0.5[3]. This study evaluated eyes with eccentricity between 0.06 and 0.88, well outside of this average range. There seemed to be no correlation between eccentricity value and accuracy of the software.

The results from this study indicate that Medmont Studio software is able to predict fluorescein patterns for a wide range of keratometry values. Simulated keratometry values in the study ranged from 47.94 diopters (7.04 millimeters) to 37.92 diopters (8.9 millimeters), and corneal cylinder power ranged from 0.12 diopters to 3.11 diopters. This study did not include subjects with extremely high or lower keratometry values or high astigmatism. More research must be done to determine how well the Medmont Studio works for these outliers.

In conclusion, Medmont Studio software is able to accurately predict fluorescein patterns on eyes with average parameters. For most eyes, Medmont Studio software is a viable option for empirically ordering gas permeable lenses. The software may significantly decrease the number of diagnostic lenses tried before a successful fit is achieved and significantly decrease chair time for the optometrist.

References

1. Ronneburger A, Basarab J, Howland HC. Growth of the cornea from infancy to adolescence. Ophthalmic Physiol Opt. 2006 Jan;26(1):80-7.

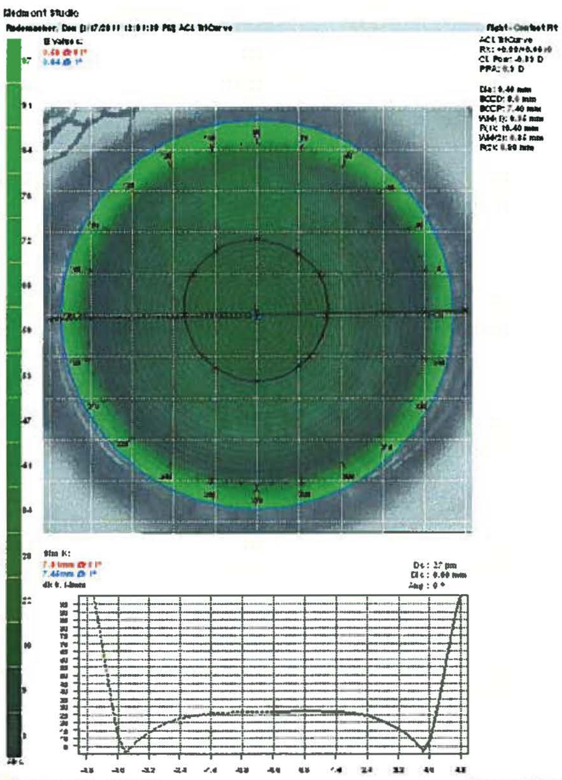
2. Caroline P, Andre M. Effects of corneal eccentricity. Contact Lens Spectrum. 2010 Nov.

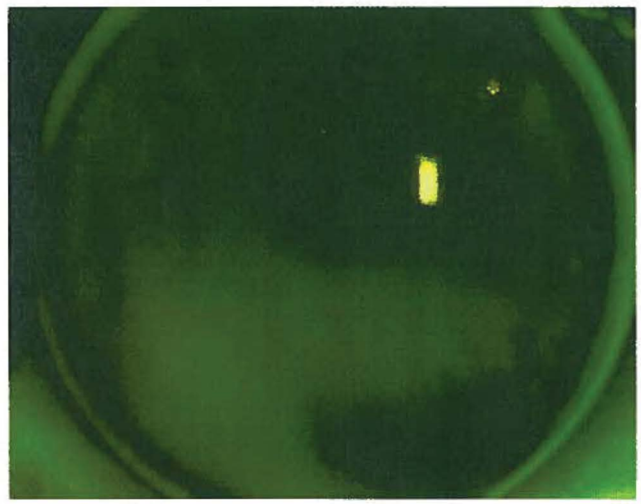
3. Bennett E. Taking the mystery out of orthokeratology. Contact Lens Spectrum. 1997 Apr.

4. Yanoff M, Duker J. Clinical Ophthalmology. 3rd ed. St. Louis, Mo: Mosby Elsevier, 2008. Chap 4.1.

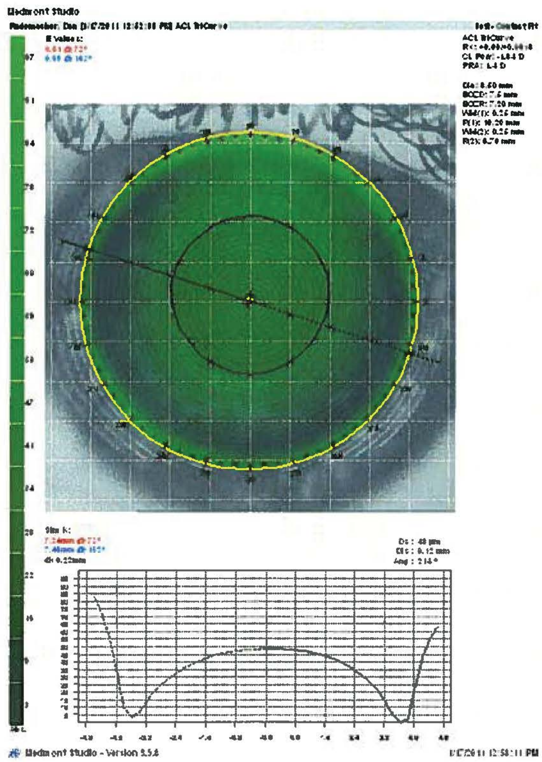
Appendix A. Fitting Data and Analysis

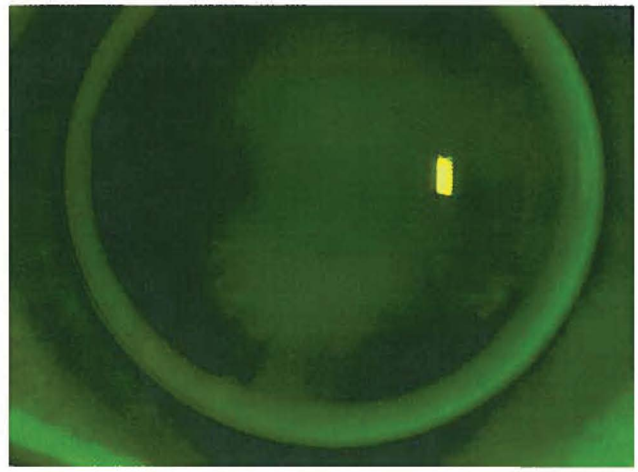
Patient 1
OD:
Sim K's: 7.91 @ 091; 7.46 @ 001
Fit with Lens #2: BC 7.4, Dia 9.4
Projected FL pattern: slightly steep centrally
Actual FL pattern: slightly steep centrally
Analysis: projected FL pattern correlates well with actual FL pattern



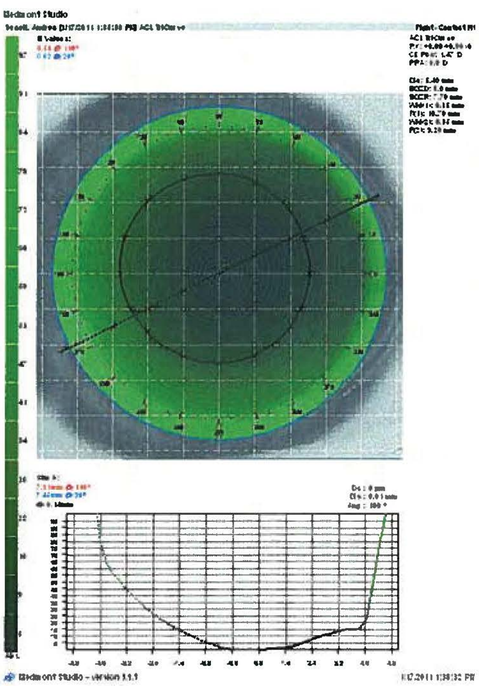


Sim K's: 7.42 @ 072; 7.48 @ 162
Fit with Lens #1: BC 7.2, Dia 8.5
Projected FL pattern: steep centrally
Actual FL pattern: steep centrally
Analysis: projected FL pattern correlates well with actual FL pattern

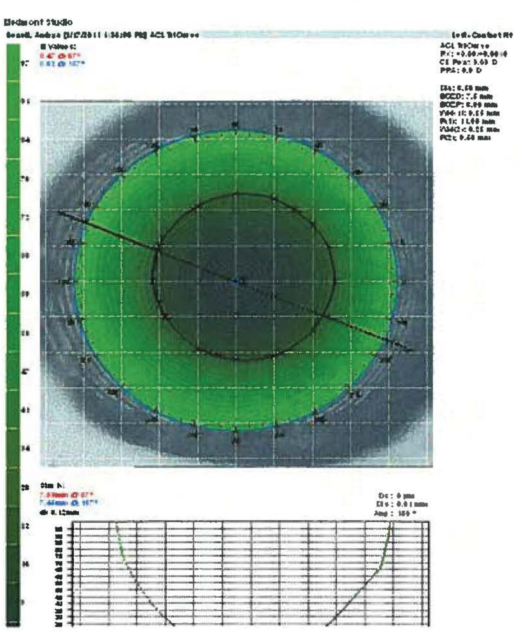


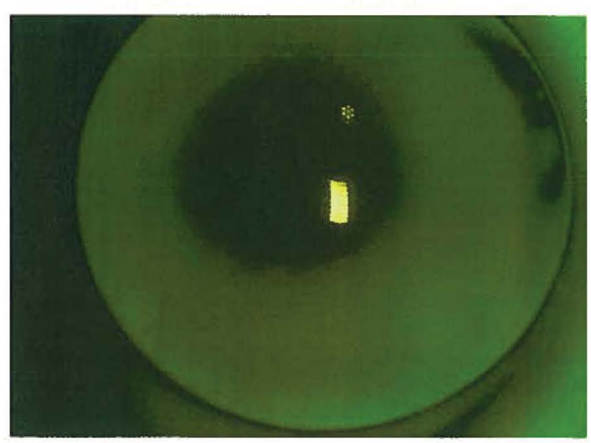


Patient 2
OD:
Sim K's: 7.31 @ 116; 7.46 @ 026
Fit with Lens #4: BC 7.7, Dia 9.4 (intentionally fit flat)
Projected FL pattern: flat, central bearing, mid-peripheral pooling
Actual FL pattern: very flat, significant central bearing, mid-peripheral pooling
Analysis: projected FL pattern correlates with actual FL pattern



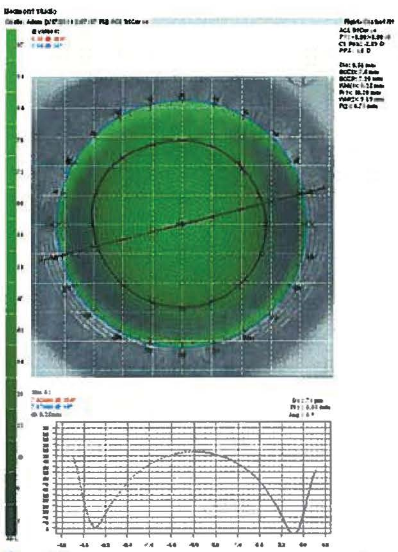
OS:
Sim K's: 7.33 @ 076; 7.46 @ 167
Fit with Lens #6: BC 7.9 Dia 8.5 (intentionally fit flat)
Projected FL pattern: central bearing, mid-peripheral pooling
Actual FL pattern: very flat, central bearing, mid-peripheral pooling
Analysis: projected FL pattern correlates with actual FL pattern

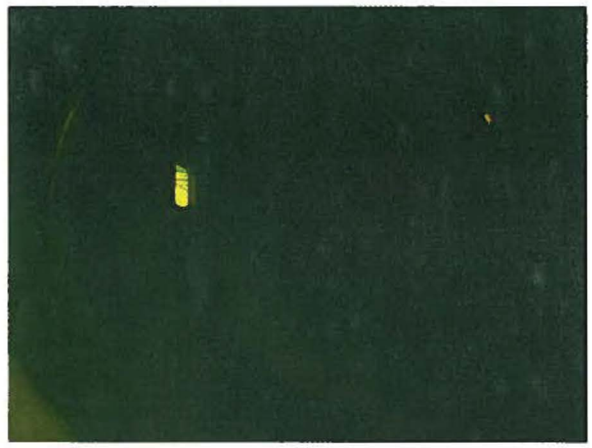




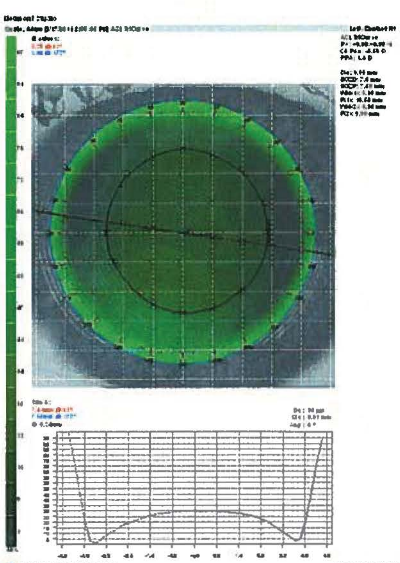
Patient 3

OD:
Sim K's: 7.42 @ 104; 7.67 @ 014
Fit with lens #1: BC 7.2, Dia 8.5 (intentionally fit steep)
Projected FL pattern: steep, central pooling
Actual FL pattern: poor image, appears steep with central pooling
Analysis: appears to correlate with projected FL pattern

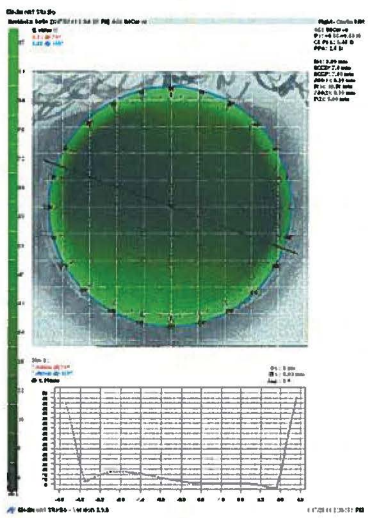




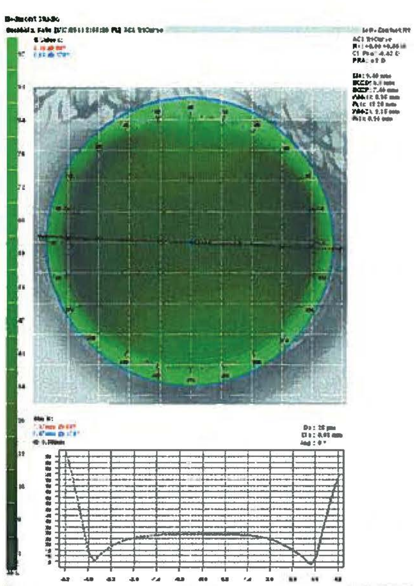
OS:
Sim K's: 7.41 @ 082; 7.65 @ 172
Fit with lens #2: BC 7.4, Dia. 9.4
Projected FL Pattern: slightly steep, mild central pooling
Actual FL Pattern: fairly good alignment, very diffuse pooling throughout lens
Analysis: actual FL pattern fits closer to alignment than projected pattern



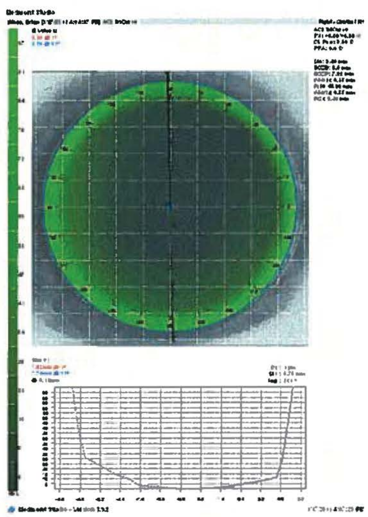
Patient 4
OD:
Sim K's: 7.04 @ 070; 7.43 @ 160
Fit with lens #3: BC 7.5, Dia 9.0 (intentionally fit flat)
Projected FL pattern: feather central touch across 3-9 band, corneal cylinder apparent
Actual FL pattern: flat across 3-9 band, mid-peripheral pooling
Analysis: close representation of actual pattern by the projected pattern, more dramatic appearance of actual pattern

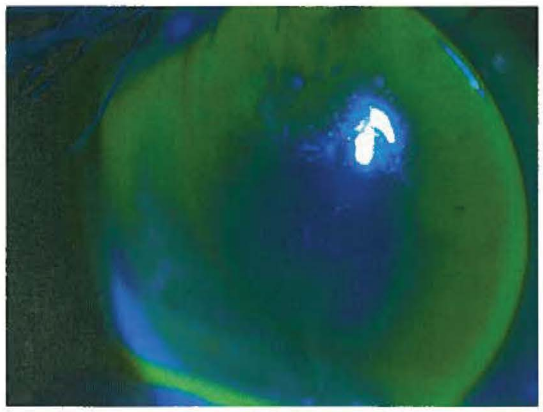



OS:
Sim K's: 7.17 @ 088; 7.47 @ 178
Fit with lens #2: BC 7.4, Dia. 9.4
Projected FL pattern: aligned fit of lens
Actual FL pattern: alignment of lens
Analysis: good correlation between projected and actual FL pattern

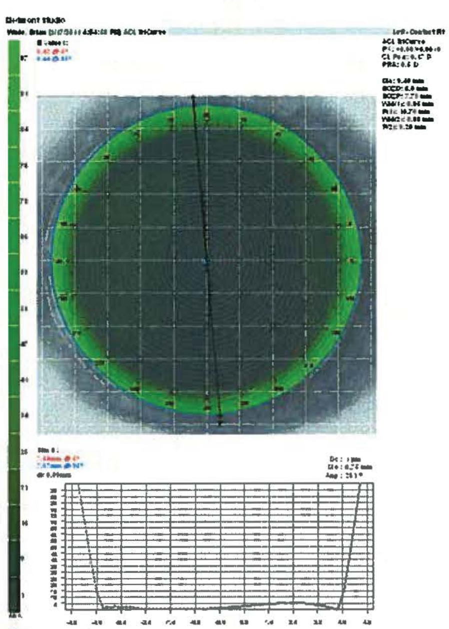


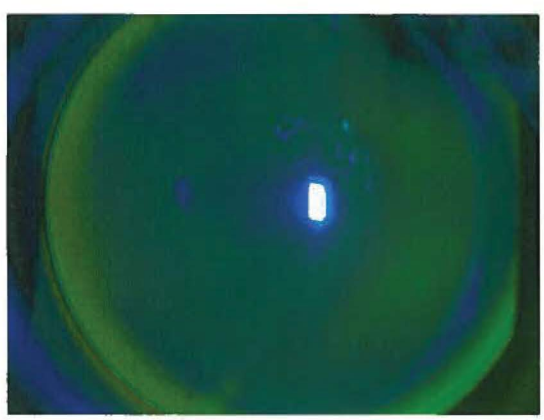

Patient 5
OD:
Sim K's: 7.62 @ 001; 7.74 @ 091
Fit with lens #5: BC 7.9, Dia. 9.4 (intentionally fit flat)
Projected FL pattern: flat, central touch, mid-peripheral pooling
Actual FL pattern: flat, central touch, mid-peripheral pooling
Analysis: projected pattern correlates well with actual FL pattern





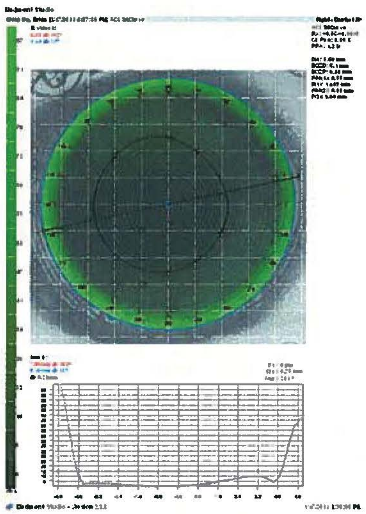
OS:
Sim K's: 7.69 @ 006; 7.67 @ 096
Fit with lens # 4: BC 7.7, Dia. 9.4
Projected FL pattern: slightly flat, near alignment fit
Actual FL pattern: alignment fit
Analysis: projected FL pattern correlates fairly well with actual FL pattern

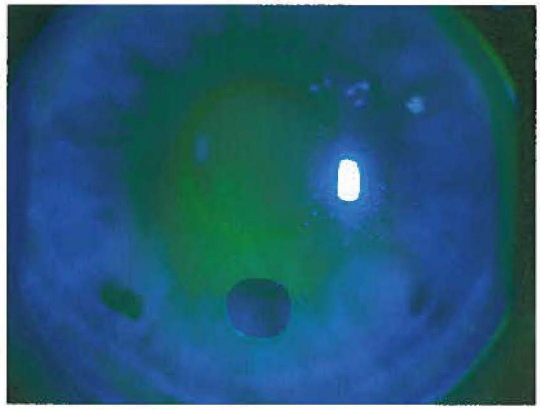




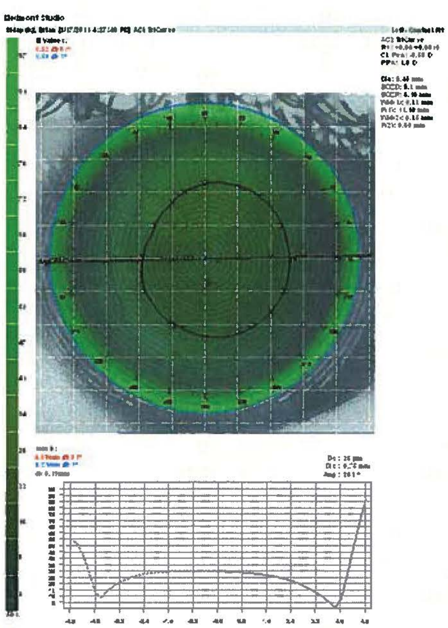
Patient 6

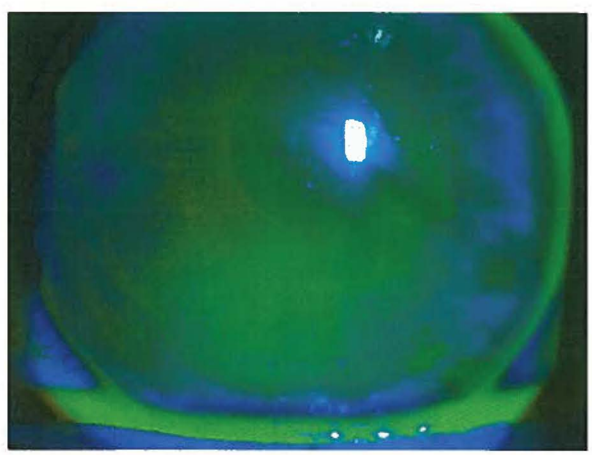
OD:
Sim K's: 7.96 @ 102; 8.19 @ 012
Fit lens #6: BC 8.00, Dia 8.5
Projected FL pattern: alignment fit
Actual FL pattern: aligned fit (picture shows insertion bubble)
Analysis: projected pattern correlates with actual pattern





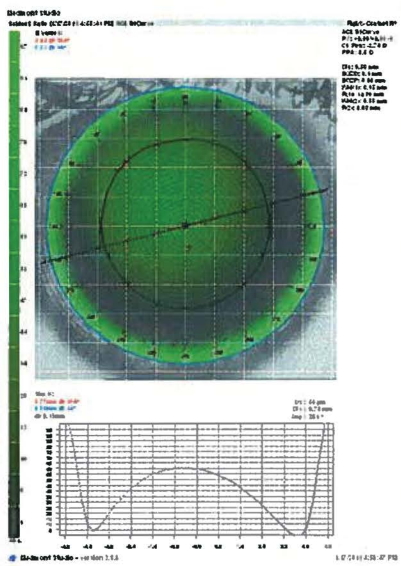
OS:
Sim K's: 8.03 @ 091; 8.20 @001
Fit lens # 7: BC 8.1, Dia. 9.4
Projected FL pattern: alignment fit
Actual FL pattern: alignment fit
Analysis: projected pattern correlates with actual pattern

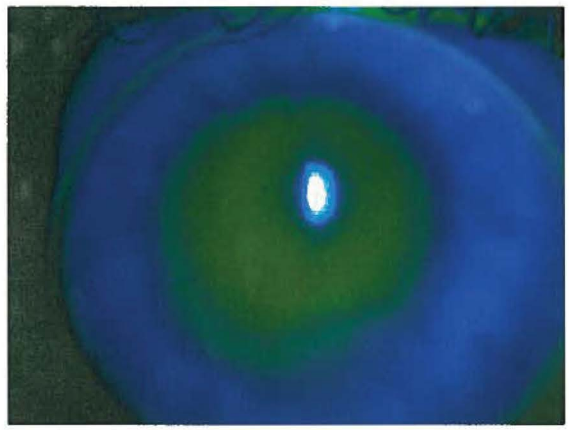




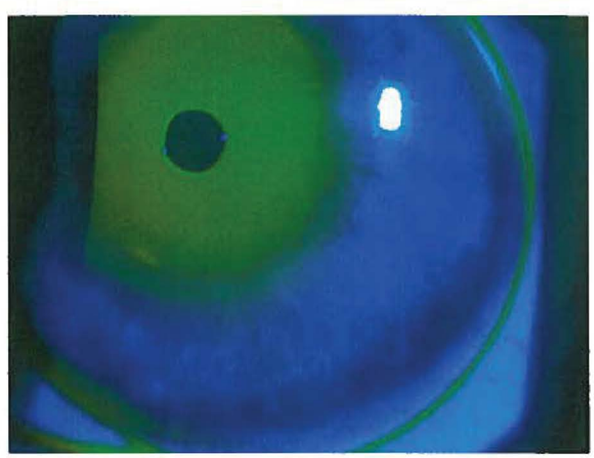
Patient 7

OD:
Sim K's: 8.77 @ 104; 8.90 @ 014 (post-surgical PRK)
Fit lens #8: BC 8.3, Dia 9.5
Projected FL pattern: very steep centrally, mid-peripheral bearing
Actual FL pattern: steep central pooling, bearing mid peripheral
Analysis: projected pattern correlates well with actual FL pattern



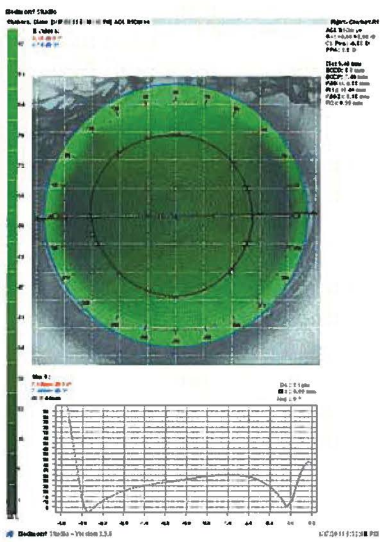


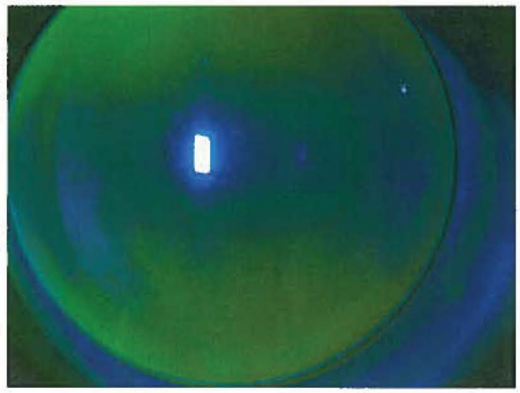
OS:
Sim K's: 8.66 @ 068; 8.72 @ 148
Fit lens #8: BC 8.3, Dia. 9.5
Projected FL pattern: very steep centrally with mid-peripheral bearing
Actual FL pattern: very steel central with bubble, bearing mid-peripherally
Analysis: very good correlation between projected and actual FL patterns



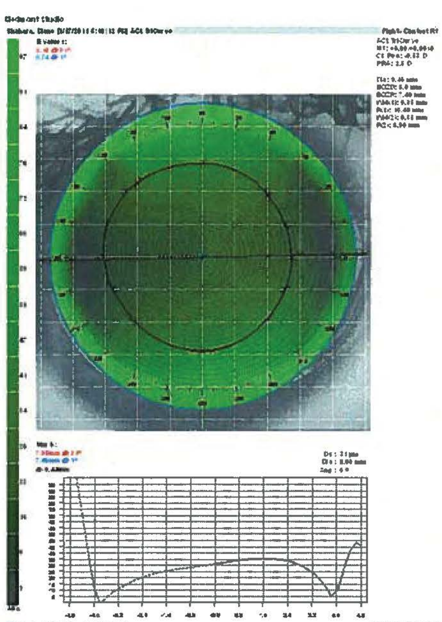
Patient 7

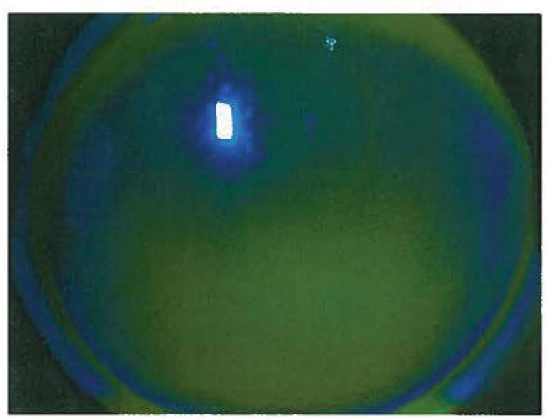
OD:
Sim K's: 7.06 @ 091; 7.43 @ 001
Fit lens #2: BC 7.4, Dia. 9.4
Projected FL pattern: steep from 12-6, aligned from 3-9
Actual FL pattern: steep from 12-6, aligned from 3-9
Analysis: good correlation between projected and actual FL patterns





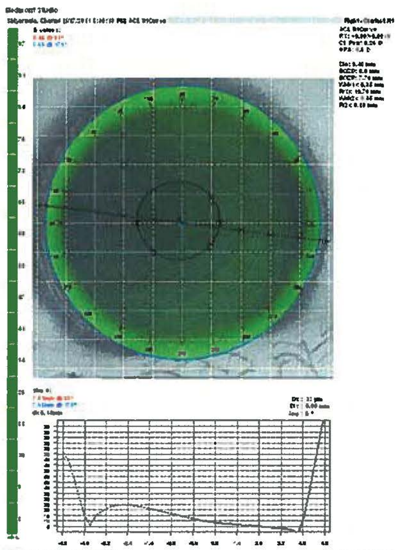
OS:
Sim K's: 7.12 @ 088; 7.62 @ 178
Fit lens #2: BC 7.4, Dia. 9.4
Projected FL pattern: steep from 12-6, aligned from 3-9
Actual FL pattern: steep from 12-6, aligned from 3-9
Analysis: good correlation between projected and actual FL patterns

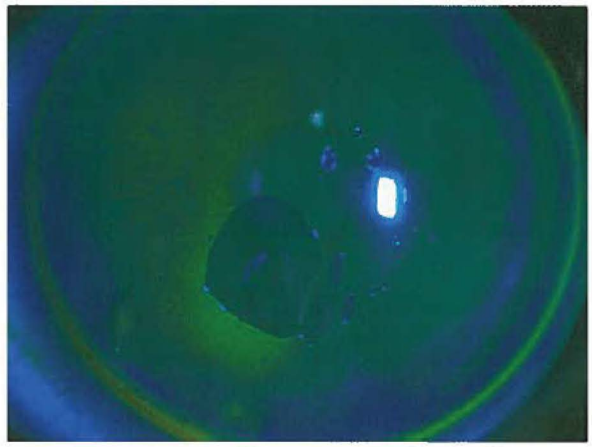




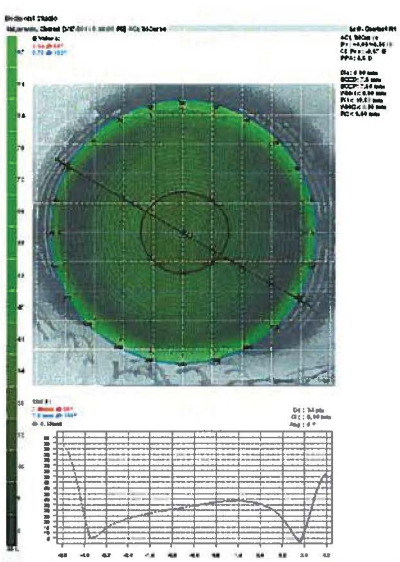
Patient 8 (small HVID)

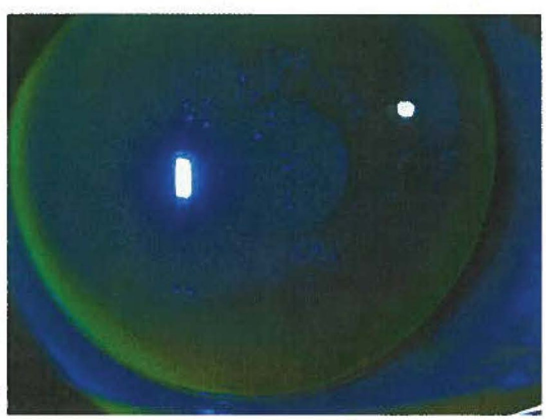
OD;
Sim K's: 7.60 @ 088; 7.66 @ 178
Fit lens #4: BC 7.7, Dia 9.4
Projected FL pattern: alignment fit
Actual FL pattern: steep centrally with bubbles
Analysis: poor correlation; small HVID doesn't translate in projected pattern





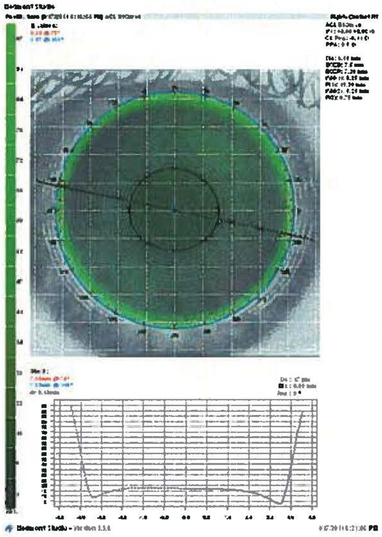
OS:
Sim K's: 7.48 @ 060; 7.61 @ 160
Fit lens #3: BC 7.5 Dia 9.0
Projected FL pattern: slightly steep centrally
Actual FL pattern: steep centrally with dimple veiling
Analysis: poor correlation, small HVID doesn't translate in projected pattern

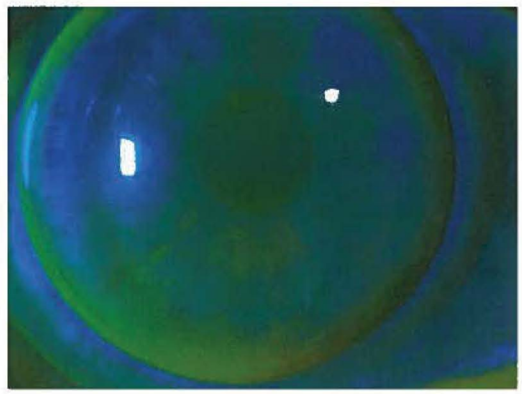




Patient 10

OD:
Sim K's: 7.09 @ 078; 7.22 @ 168
Fit lens #1: BC 7.2, Dia 8.5
Projected FL pattern: aligned fit
Actual FL pattern: good alignment, feather touch
Analysis: good correlation between projected and actual FL patterns





OS:
Sim K's: 7.10 @ 148; 7.28 @ 068
Fit lens #1: BC 7.2, Dia 8.5
Projected FL pattern: aligned fit
Actual FL pattern: slightly flat, near aligned
Analysis: fairly good correlation with projected and actual FL patterns