Mapping the aspheric characteristics of the Boston Envision contact lens using the EyeSys corneal topographer

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ABSTRACT The Boston Envision contact lens is billed as a posterior aspheric design to improve fitting characteristics. A well fitting lens is a resource any practitioner would like to have, yet the exact nature of the Envision's asphericity is regarded as "proprietary information"[1]. Using the EyeSys corneal topographer it was shown that there was only a miniscule amount of asphericity present and we should not confuse this lens with a true aspheric lens. The calculated eccentricity of the 4 Envision lenses measured was minimal and likely clinically negligible.

INTRODUCTION

Every day it seems the contact lens practitioner is faced with yet another new lens design or material to offer his patients. Boston has not so recently unveiled the Envision lens design which has enjoyed one of the most aggressive marketing campaigns among any contact lens. The bulk of this advertising campaign has been aimed at our patients, rather than our colleagues, via television. This is an approach that may not be totally familiar to the practitioner, nor acceptable.

Boston claims the Envision design is aspheric which gives better cornea-lens alignment with a more uniform tear lens cushion and less bearing. This aspheric design is the focus of this project and will be investigated using the EyeSys System corneal topographer.

MATERIALS AND METHODS

The Boston Envision contact lens from Polymer Technology Corporation is a lens design made of the Boston RXD material. RXD is a fluorosilicone acrylate rigid gas permeable material with a Dk of 45. The lens is available in base curves from 7.30 to 8.30 in 0.1mm increments and overall diameters of 9.3 to 10.3mm.

The EyeSys corneal topographer was used to determine the curves of the posterior surface of a given Envision lens. The EyeSys System from EyeSys Laboratories, Inc. is capable of measuring convex or concave optical surfaces with a maximum diameter of approximately 9mm.

Four Envision lenses were obtained from Art Optical in Grand Rapids, Michigan. Their base curves were verified using a radiuscope at 7.50, 7.70, 7.90 and 8.10 +/-0.02mm. The overall diameter of the lenses was 9.3mm and the back vertex powers were -3.00D except for the 7.90 lens which measured -2.75D.

The lenses were mounted on an apparatus with a square bowl type profile using Vitamin A drops. The bowl is approximately 4.5mm in diameter and 3.0mm deep so that a drop or two of solution can be put into the bowl and then the anterior surface of the lens is mounted on the bowl. Hydrostatic forces hold the lens onto the bowl. Care must be taken to align the lens such that a line tangent to the optical center will have a line perpendicular to it passing through the optical center. This line will then intersect the center of the smallest mire of the videokeratoscope. Misalignment will result in the topographer reading toricity into the lens which is not detectable with a radiuscope or lensometer.

Each lens was "shot" 3 times and the radius of curvature at each 1mm concentric zone from central to 9mm peripheral was recorded. A small amount of toricity was also revealed by the topographer when the lenses were stored dry prior to "shooting" the image. Hydration in Boston conditioning solution before shooting eliminated nearly all of this small amount of toricity.

RESULTS

After three readings were done on each lens, the radius of curvature at each concentric zone was averaged and these values are reported in table 1 for each lens. A combination printout

Table 1

Lens	7.50	7.70	7.90	8.10
central	7.50	7.70	7.89	8.09
1 mm	7.50	7.70	7.89	8.09
2 mm	7.49	7.70	7.88	8.08
3 mm	7.49	7.69	7.88	8.07
4 mm	7.49	7.69	7.87	8.05
5 mm	7.49	7.69	7.87	8.04
6 mm	7.50	7.69	7.87	8.05
7 mm	7.56	7.75	7.91	8.08
8 mm	7.63	7.81	7.98	8.17
9 mm	7.71	7.86	8.01	8.21

Table 2

Lens	7.50	7.70	7.90	8.10
e-value	0.114	0.100	0.087	0.089

from the EyeSys for each lens is included also. This printout includes a color map showing the contour of the surface, a corresponding keratometric type map which shows the steepest and flattest meridians and the bottom graph is a profile contour map of the steepest and flattest meridians with the difference between the two included. The values in table 1 were then used to calculate eccentricity values or "e-values". The calculated e-values are reported in table 2.

DISCUSSION

The human cornea does not have a constant radius of curvature. It becomes progressively flatter from center to peripheral areas which is the definition of asphericity. The rate and amount of peripheral flattening are highly variable from one person to the next.[2] It stands to reason that a contact lens that can match the flattening rate of the cornea will provide a more uniform tear lens, reduce bearing and give overall better fitting characteristics.

The asphericity of a lens depends on its e-value, which is its degree of flattening or departure from a true circle. An aspheric posterior surface is ellipsoidal when its e-value is less than 1.0, parabolic when its e-value is 1.0 and hyperbolic when its e-value is greater than 1.0. This means that the rate of base curve flattening increases with larger e-values.[3-5]

The posterior surface of the Boston Envision contact lens consists of an ellipsoidal central posterior optical zone that merges into a peripheral hyperbolic curve.[6] The 9.3mm diameter lenses were chosen for this project because the EyeSys could capture a larger portion of the smaller lens, approximately 9mm or slightly less. The optic zone on these lenses is hard to measure due to a high degree of blending the optic zone into the periphery, but it is well approximated at 7.5mm. Boston does not specify an optic zone size on these lenses because it would not complement their description of the lens (above) which states the ellipsoidal curve merges into a peripheral hyperbolic curve. This implies a changing e-value in moving from the center of the lens towards the periphery.

When the data was analyzed to put an overall e-value to these Envision lenses, the central radius and the peripheral radius at the 9mm concentric zone were used. The e-values ranged from 0.087 to 0.114, surprisingly low from what one would expect by reading Boston's description of the lenses' characteristics. Looking at the data in table 1 it is obvious that virtually no flattening occurs from the central reading to the 7mm zone. From the 7mm zone to the 9mm zone is where virtually all of the flattening occurs that is evident with the EyeSys corneal topographer.

McCarey et al researched and tested the accuracy and reproducibility of the very same EyeSys corneal topographer that was used in this project. EyeSys Laboratories claims a reproducibility of 0.25D (0.05mm) which is 5 times greater than the apparent precision of the instrument reflected in the values output by the software reading to the nearest 0.01mm. McCarey et al showed that when measuring spheres of a known radius, the EyeSys overestimated by an average of 0.34D (0.068mm), yet had a reproducibility within 0.13D (0.026mm) seventy five percent of the time and the average error in multiple measurements was 0.11D (0.022mm).(7) Keeping in mind that the <u>difference</u> between central and peripheral curves is the important information here, these mild inaccuracies should not cast doubt on the data collected.

Upon inspection of the color contour map of the lenses, it is evident that some toricity has entered the readings. However, the software package will average all the readings for a given concentric zone and these were the values used herein. McCarey and co-workers have also shed some light on this apparent toricity issue. The astigmatism reported by the system when measuring a sphere may be due to outputting values with an accuracy equal to the instrument resolution and greater than its reproducibility. The output is deceptive and leads one to believe that toricity exists when, in fact, it may not.(7) For their purposes, McCarey et al averaged the steepest and flattest meridians, yielding the spherical equivalent, which is very similar to the method used here. The largest delta k value recorded on the contour map was 0.07mm.

CONCLUSION

The Boston Envision contact lens is a viable option for the practitioner. Its material has a fairly high Dk value and it can also be obtained with a UV blocker. However, Boston's claims of being an aspheric lens are significantly refuted with the data gathered here. There is no apparent flattening in the central 6mm, a negligible amount when the 7mm zone is considered and a small amount when 9mm of the 9.3mm lens is analyzed. This means that most of the flattening occurs outside of the optic zone area. The overbearing question here is "how does this differ from a well blended tricurve lens?" As mentioned earlier, the Envision lens is a viable option for the practitioner fitting RGP lenses, as long as he knows what it is and what to expect from it in lens performance. This lens design is not one to end all others.

REFERENCES

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OD

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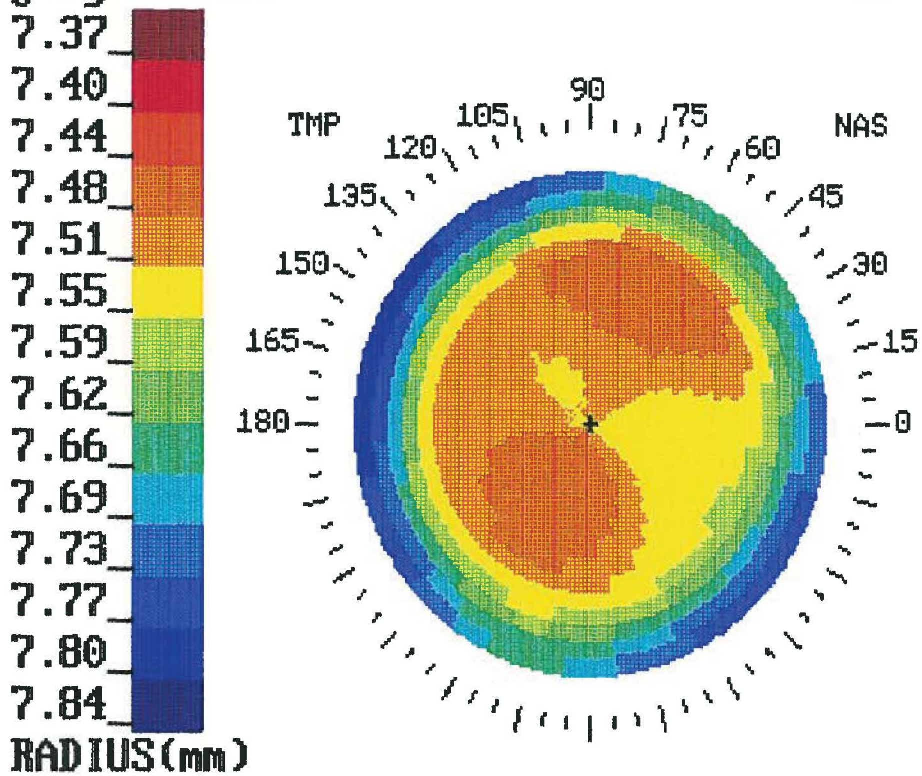
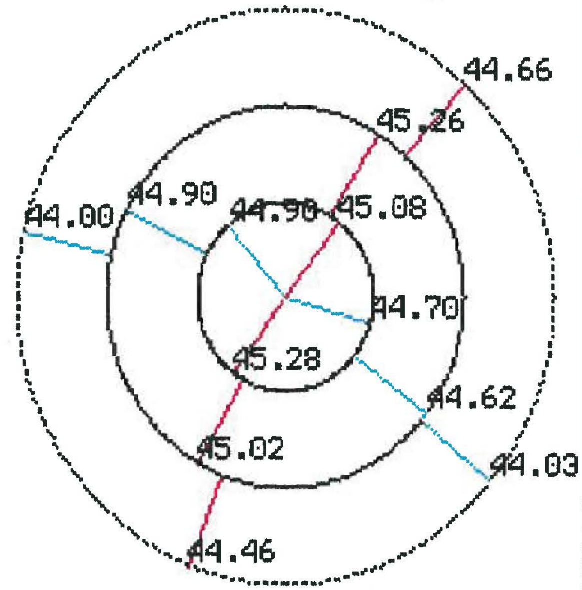




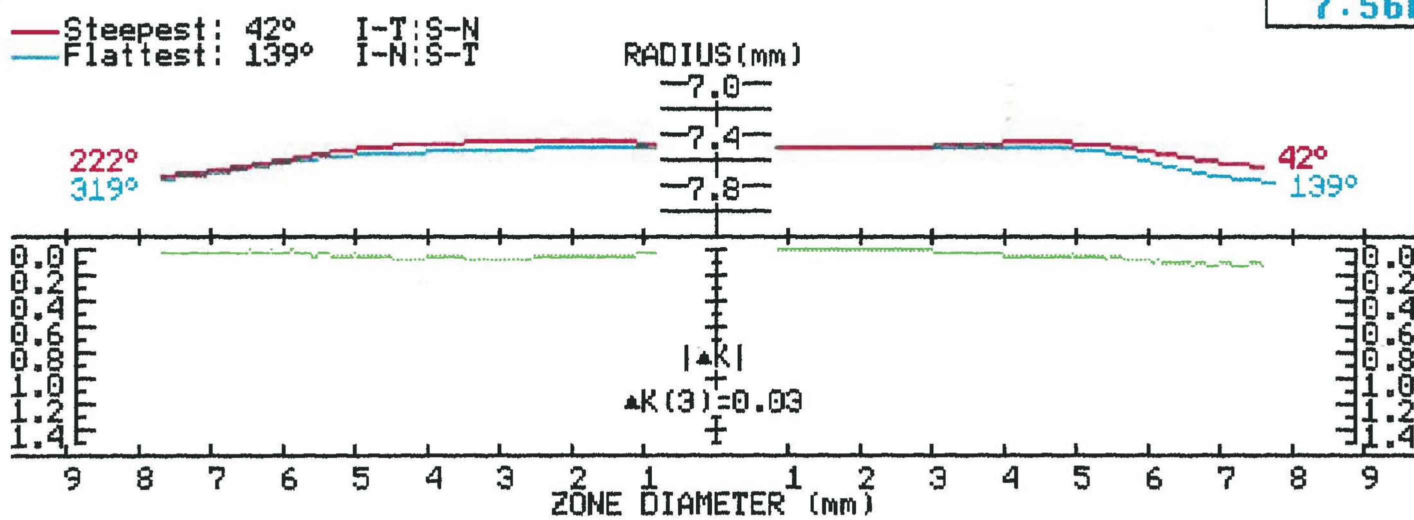
KERATOMETRIC DATA
3 mm Zone

7.47mm @ 42°
7.51mm @ 132°
▲ 0.04mm @ 42°

SEMIMERIDIAN DATA

3 mm Zone
7.45mm @ 235°
7.48mm @ 53°
7.51mm @ 131°
7.55mm @ 344°

5 mm Zone
7.45mm @ 58°
7.49mm @ 241°
7.51mm @ 153°
7.56mm @ 323°



EyeSys Corneal Analysis System

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OD

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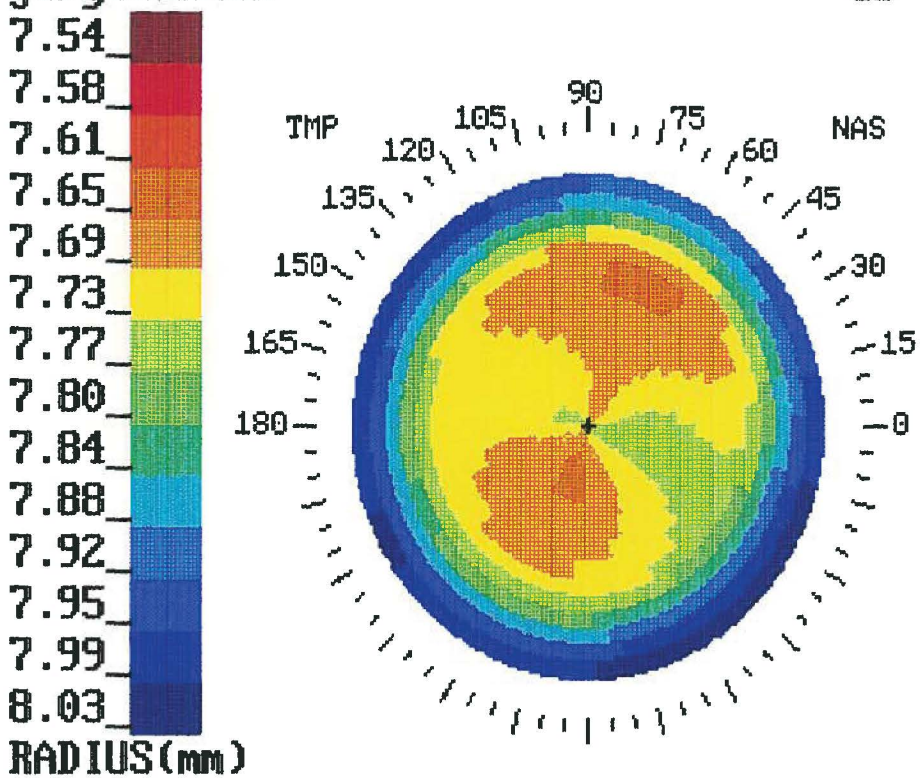
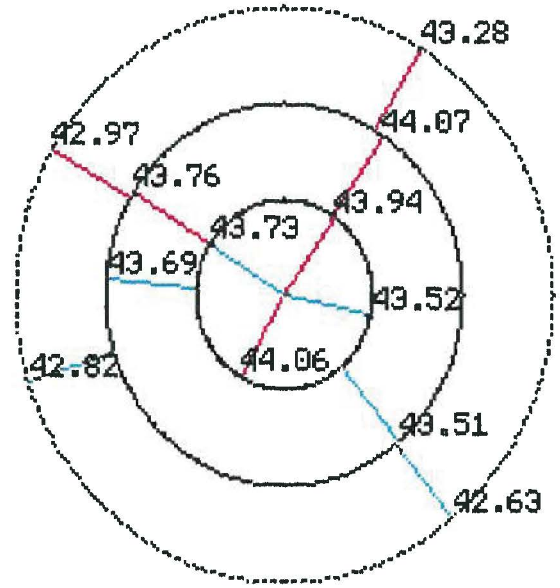




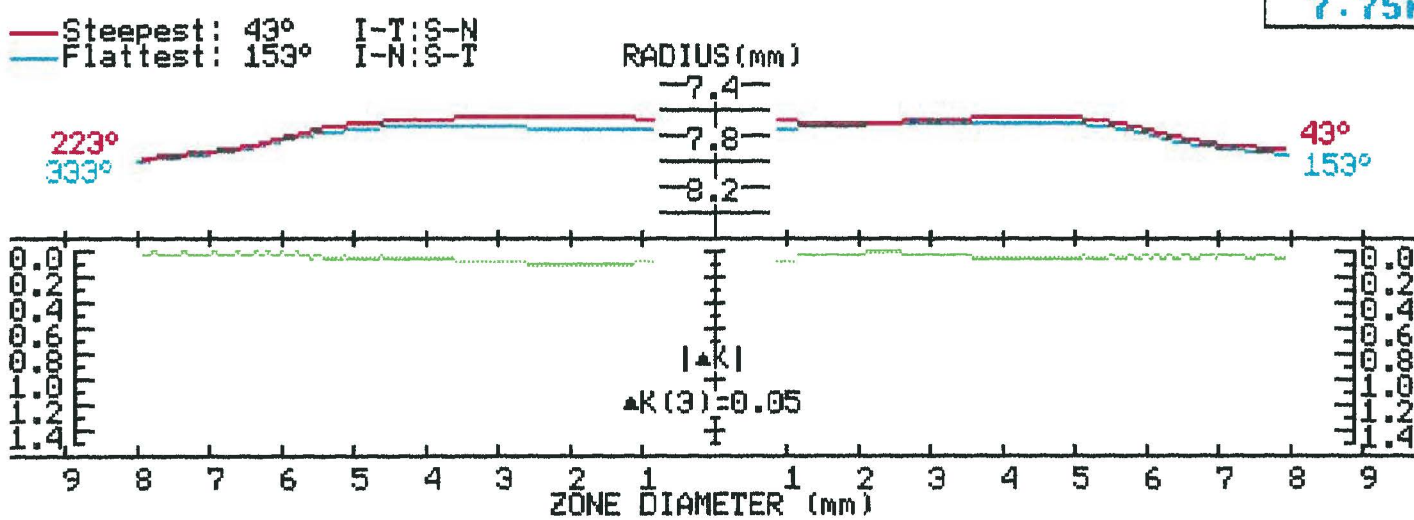
KERATOMETRIC DATA
3 mm Zone

7.67mm @ 43°
7.71mm @ 133°
▲ 0.04mm @ 43°

SEMIMERIDIAN DATA

3 mm Zone
7.66mm @ 240°
7.68mm @ 55°
7.71mm @ 147°
7.75mm @ 347°

5 mm Zone
7.65mm @ 56°
7.71mm @ 147°
7.72mm @ 175°
7.75mm @ 310°



EyeSys Corneal Analysis System

garytackman

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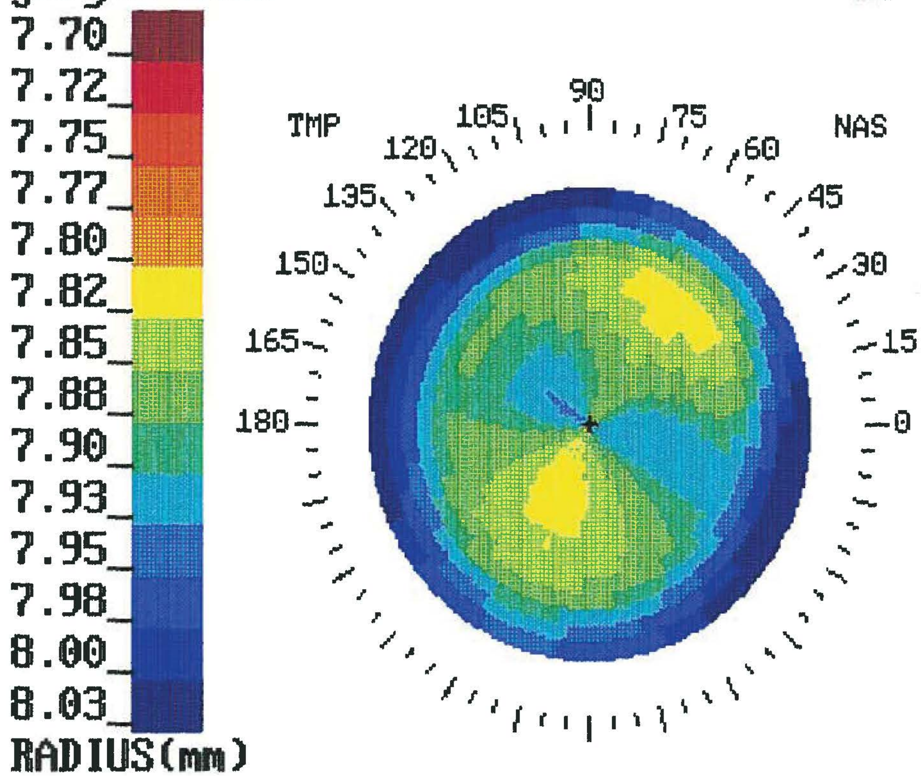
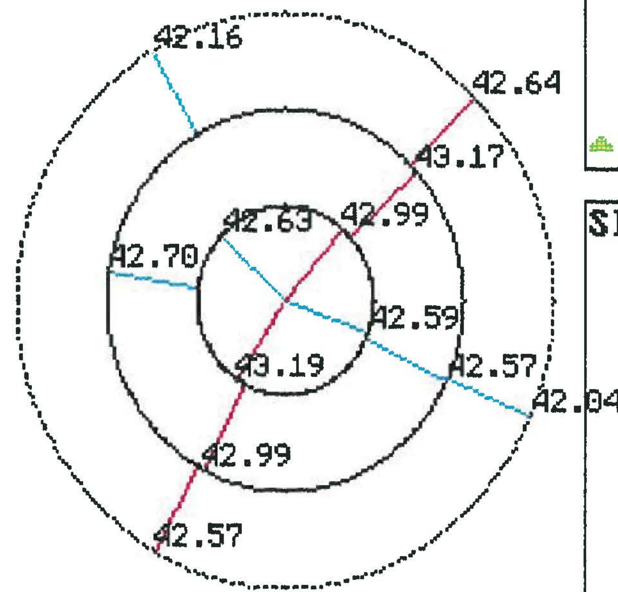




KERATOMETRIC DATA
3 mm Zone

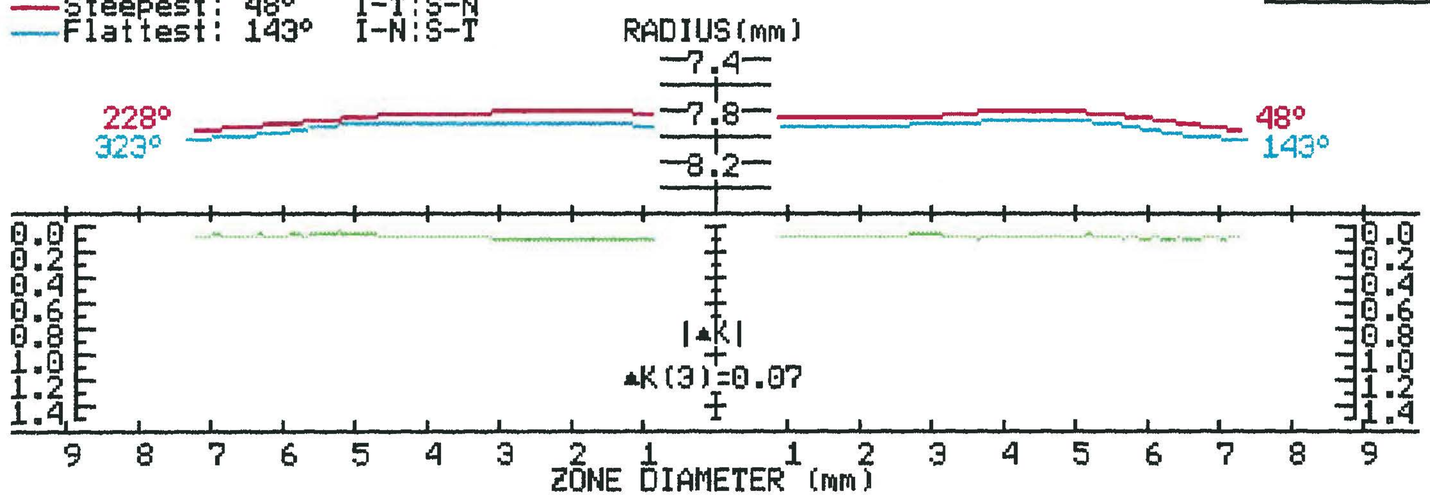
7.83mm @ 48°
7.90mm @ 138°
▲ 0.07mm @ 40°

SEMIMERIDIAN DATA

3 mm Zone
7.81mm @ 237°
7.85mm @ 50°
7.91mm @ 137°
7.92mm @ 340°

5 mm Zone
7.81mm @ 42°
7.85mm @ 243°
7.90mm @ 171°
7.92mm @ 335°

—Steepest: 48° I-T:S-N
—Flattest: 143° I-N:S-T



EyeSys Corneal Analysis System

garytackman

OD

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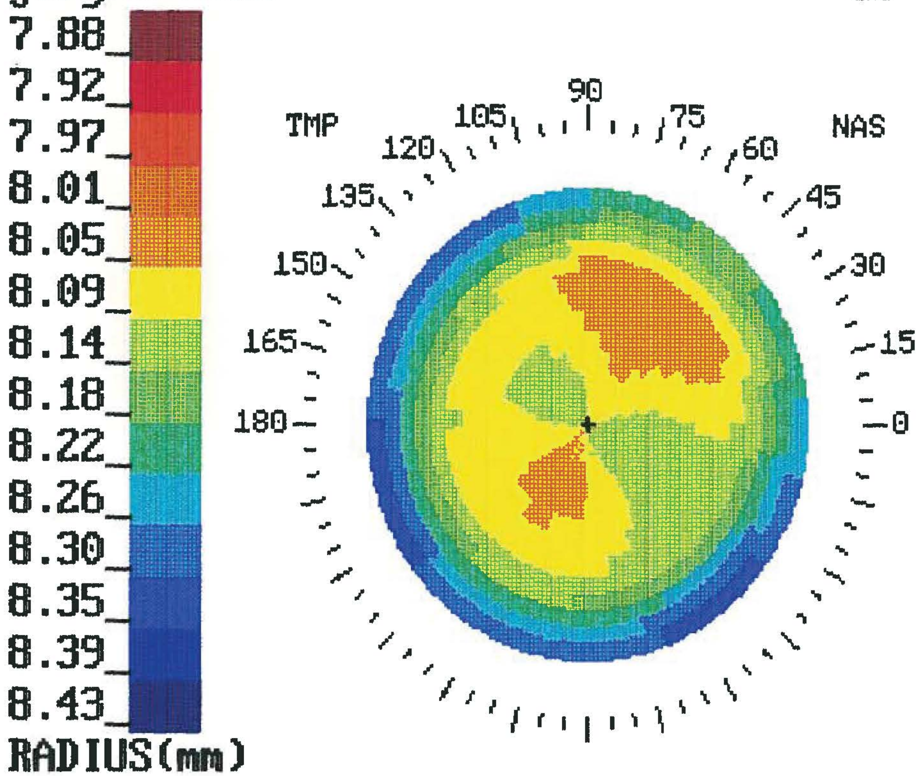
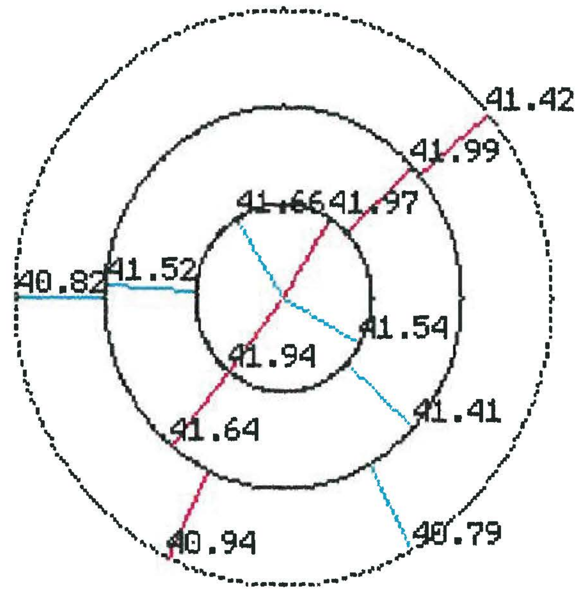




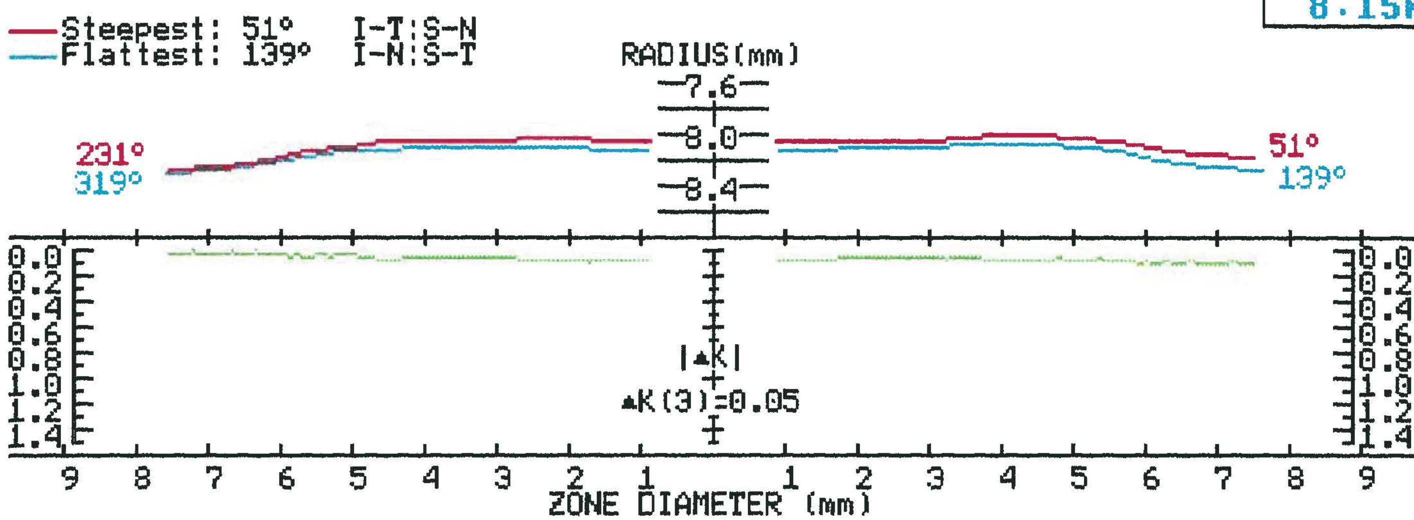
KERATOMETRIC DATA
3 mm Zone

8.04mm @ 51°
8.11mm @ 141°
▲ 0.07mm @ 51°

SEMIMERIDIAN DATA

3 mm Zone
8.04mm @ 57°
8.04mm @ 233°
8.10mm @ 123°
8.12mm @ 330°

5 mm Zone
8.03mm @ 44°
8.10mm @ 231°
8.12mm @ 176°
8.15mm @ 317°



EyeSys Corneal Analysis System