Principles of Flexure with The Boston Envision Lens Senior Project

By
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Introduction: The majority of corneas flatten from apex to the periphery with differing ecentricity. The central area of the cornea tends to be of low ecentricity in the range of approximately 0.3, but the mid-periphery begins to flatten at a rate of apporximately 0.7. Not all corneas are the same however, some corneas are actually steeper in the mid-periphery than in the center apical region. This is however is rare. The concept of the Boston Envision lens is to match the posterior surface of the RGP lens to the geometry of the cornea, specifically multiple ecentricities. This should provide the patient with a better physical fit and the practioner with a more forgiving fit. This explains the concept of the Boston Envision lens. Flexure is infuenced by three main factors: corneal topography; lens thickness; and physical characteristics of the material. Fitting relationship of the lens to the cornea, and eye lid tension also influence the amount of flexure. This explains the concept of flexure as studied in this report. The purpose of this study is to show the amount of flexure possible and the type of flexure that occurs with a standard Boston Envision lens as measured by over refraction, and over K's.

Methods: To study flexure subjects were required to have at least 1.00 diopters of cylinder in their habitual Rx. Seven subjects were tested,(14 eyes). Habitual Rx cylinder ranges were from -2.50 diopters to -1.00 diopters, corneal cylinder ranges were from 3.25 diopters to pl. The fitting set used was a boston envision fitting set with the diameter of 9.6; B.C. ranges used were from 7.40 to 8.10; and the fitting set contact lens power was -3.00 diopters. The average center thicknesses for this particular fitting set was .15mm, with no more than .01mm difference between each contact lens center thickness. Each subject tested was fitted with a contact lens on K; .50 steeper than K; .50 flatter than K. Each lens fitted was put through two tests, an over refraction and keratometry measurements.

patient #1

Habitual Rx	O.D. -.50 -1.00 X 035		20/15	
	O.S. +.50 -2.50 X 135		20/15	
K Readings	O.D. 43.75 @ 038		44.75 @ 128	
	O.S. 45.75 @ 048		43.75 @ 138	
Contact fit on K		B.C.	Dia.	Power
	O.D.	7.70	9.6	-3.00
	O.S.	7.70	9.6	-3.00
over refraction	O.D. +1.50 -.25 X 045		20/15	
	O.S. +2.25 -.75 X 135		20/15	
over K	O.D. 41.50 @ 015		41.50 @ 105	
	O.S. 41.50 @ 015		41.50 @ 105	
Contact fit .50 steep		B.C.	Dia.	Power
	O.D.	7.60	9.6	-3.00
	O.S.	7.60	9.6	-3.00
over refraction	O.D. +1.50 sph		20/15	
	O.S. +2.25 -.50 X 125		20/15	
over K	O.D. 41.50 @ 025		42.00 @ 115	
	O.S. 41.75 @ 066		42.00 @ 154	
Contact fit .50 flat		B.C.	Dia.	Power
	O.D.	7.80	9.6	-3.00
	O.S.	7.80	9.6	-3.00
over refraction	O.D. +2.00 sph		20/15	
	O.S. +3.25 -.75 X 135		20/15	
over K	O.D. 40.75 @ 010		41.00 @ 100	
	O.S. 40.75 @ 020		41.00 @ 110	

Patient #2

Habitual Rx	O.D.	-6.25 -1.00 X 180	20/15	
	O.S.	-6.00 -1.00 X 180	20/15	
K Readings	O.D.	42.75 @ 180	44.00 @ 090	
	O.S.	43.00 @ 172	44.00 @ 082	
Contact fit on K		B.C.	Dia.	Power
	O.D.	7.90	9.6	-3.00
	O.S.	7.80	9.6	-3.00
over refaction	O.D.	-2.00 sph	20/15	
	O.S.	-2.50 sph	20/15	
over K	O.D.	40.00 @ 180	40.00 @ 090	
	O.S.	40.50 @ 170	40.25 @ 080	
Contact fit .50 steep		B.C.	Dia.	Power
	O.D.	7.80	9.6	-3.00
	O.S.	7.70	9.6	-3.00
over refraction	O.D.	-2.75 -.75 X 180	20/15	
	O.S.	-2.50 sph	20/15	
over K	O.D.	40.25 @ 180	40.87 @ 090	
	O.S.	41.00 @ 180	40.75 @ 090	
Contact fit .50 flat		B.C.	Dia.	Power
	O.D.	8.00	9.6	-3.00
	O.S.	7.90	9.6	-3.00
over refraction	O.D.	-1.75 sph	20/15	
	O.S.	-2.25 sph	20/15	
over K	O.D.	39.25 @ 180	39.25 @ 090	
	O.S.	40.00 @ 180	40.00 @ 090	

Patient #3

Habitual Rx O.D. undeterminable (kerataconus) 20/40

O.S. -.25 -1.25 X 095 20/15

K readings O.D. 42.50 @ 005 42.50 @ 095

O.S. 43.25 @ 155 42.50 @ 065

Contact fit on K		B.C.	Dia.	Power
	O.D.	7.90	9.6	-3.00
	O.S.	7.90	9.6	-3.00
over refraction	O.D.	+2.25 sph	20/15	
	O.S.	+3.00 sph	20/15	
over K	O.D.	39.50 @ 180	40.25 @ 090	
	O.S.	39.75 @ 180	39.50 @ 090	

Contact fit .50 steep		B.C.	Dia.	Power
	O.D.	7.80	9.6	-3.00
	O.S.	7.80	9.6	-3.00
over refraction	O.D.	+2.50 sph	20/15	
	O.S.	+2.75 -.50 X 105	20/15	
over K	O.D.	40.50 @ 180	40.50 @ 090	
	O.S.	41.00 @ 180	40.50 @ 090	

Contact fit .50 flat		B.C.	Dia.	Power
	O.D.	8.00	9.6	-3.00
	O.S.	8.00	9.6	-3.00
over refraction	O.D.	+2.50 sph	20/15	
	O.S.	+3.00 -.50 X 095	20/15	
over K	O.D.	40.50 @ 180	40.25 @ 090	
	O.S.	39.50 @ 180	39.50 @ 090	

Patient #4

Habitual Rx	O.D.	-1.25 -1.00 X 105		20/15
	O.S.	-0.75 -1.00 X 075		20/15
K readings	O.D.	42.50 @ 160	42.50 @ 070	
	O.S.	42.s75 @ 165	42.25 @ 075	
Contact fit on K		B.C.	Dia	Power
	O.D.	7.90	9.6	-3.00
	O.S.	8.00	9.6	-3.00
Over Refraction	O.D.	+0.75 -0.75 X 088		20/15
	O.S.	+1.75 -0.50 X 090		20/15
Over K	O.D.	40.00 @ 165	40.00 @ 075	
	O.S.	39.50 @ 165	39.50 @ 075	
Contact fit .50 steep		B.C.	Dia	Power
	O.D.	7.80	9.6	-3.00
	O.S.	7.90	9.6	-3.00
Over Refraction	O.D.	+0.75 -0.75 X 085		20/15
	O.S.	+1.75 -0.25 X 095		20/15
Over K	O.D.	40.50 @ 165	40.50 @ 075	
	O.S.	40.25 @ 165	40.00 @ 075	
Contact fit .50 flat		B.C.	Dia	Power
	O.D.	8.00	9.6	-3.00
	O.S.	8.10	9.6	-3.00
Over Refraction	O.D.	+2.00 -0.75 X 085		20/15
	O.S.	+2.75 sph		20/15
Over K	O.D.	39.50 @ 165	39.50 @ 075	
	O.S.	39.00 @ 165	39.25 @ 075	

Patient #5

Habitual Rx	O.D.	-7.50 -2.25 X 015	20/15	
	O.S.	-6.50 -2.50 X 160	20/15	
K readings	O.D.	43.00 @ 010	46.25 @ 100	
	O.S.	43.00 @ 165	45.50 @ 075	
Contact fit on K		B.C.	Dia	Power
	O.D.	7.80	9.6	-3.00
	O.S.	7.80	9.6	-3.00
Over Refraction	O.D.	-3.75 sph	20/15	
	O.S.	-2.50 sph	20/15	
Over K	O.D.	40.50 @ 180	40.75 @ 090	
	O.S.	40.50 @ 180	41.50 @ 090	
Contact fit .50 steep		B.C.	Dia	Power
	O.D.	7.70	9.6	-3.00
	O.S.	7.70	9.6	-3.00
Over Refraction	O.D.	-4.25 sph	20/15	
	O.S.	-3.50 sph	20/15	
Over K	O.D.	40.00 @ 010	40.50 @ 100	
	O.S.	41.00 @ 180	41.25 @ 090	
Contact fit .50 flat		B.C.	Dia	Power
	O.D.	7.9	9.6	-3.00
	O.S.	7.9	9.6	-3.00
Over Refraction	O.D.	-3.00 sph	20/15	
	O.S.	-2.00 sph	20/15	
Over K	O.D.	39.50 @ 180	40.25 @ 090	
	O.S.	39.75 @ 180	40.25 @ 095	

Patient #6

Habitual Rx	O.D.	-0.25 -1.50 X 180		20/15
	O.S.	-0.25 -1.25 X 175		20/15
K readings	O.D.	44.00 @ 180	46.00 @ 090	
	O.S.	44.00 @ 170	45.50 @ 080	
Contact fit on K		B.C.	Dia	Power
	O.D.	7.70	9.6	-3.00
	O.S.	7.70	9.6	-3.00
Over Refraction	O.D.	+2.50 -0.50 X 085		20/15
	O.S.	+2.50 -0.50 X 095		20/15
Over K	O.D.	41.50 @ 170	40.75 @ 080	
	O.S.	41.25 @ 170	42.00 @ 080	
Contact fit .50 steep		B.C.	Dia	Power
	O.D.	7.60	9.6	-3.00
	O.S.	7.60	9.6	-3.00
Over Refraction	O.D.	+2.75 -0.50 X 095		20/15
	O.S.	+2.75 sph		20/15
Over K	O.D.	41.50 @ 180	41.50 @ 090	
	O.S.	41.00 @ 180	41.50 @ 090	
Contact fit .50 flat		B.C.	Dia	Power
	O.D.	7.80	9.6	-3.00
	O.S.	7.80	9.6	-3.00
Over Refraction	O.D.	+3.75 -0.75 X 090		20/15
	O.S.	+3.00 -0.25 X 090		20/15
Over K	O.D.	40.25 @ 170	39.75 @ 080	
	O.S.	40.75 @ 170	40.25 @ 080	

Patient #7

Habitual Rx	O.D.	-4.00 -2.00 X 075		20/15
	O.S.	-4.00 -1.25 X 105		20/15
K Readings	O.D.	46.00 @ 160	44.00 @ 070	
	O.S.	46.00 @ 020	45.00 @ 110	
Contact fit on K		B.C.	Dia	Power
	O.D.	7.70	9.6	-3.00
	O.S.	7.50	9.6	-3.00
Over Refraction	O.D.	-1.50 -0.50 X 050		20/15
	O.S.	-1.00 -0.25 X 130		20/15
Over K	O.D.	41.00 @ 180	40.75 @ 090	
	O.S.	42.25 @ 170	42.25 @ 080	
Contact fit .50 steep		B.C.	Dia	Power
	O.D.	7.60	9.6	-3.00
	O.S.	7.40	9.6	-3.00
Over Refraction	O.D.	-0.75 -0.50 X 080		20/15
	O.S.	-1.75 -0.50 X 095		20/15
Over K	O.D.	41.75 @ 170	41.00 @ 080	
	O.S.	43.25 @ 010	42.25 @ 100	
Contact fit .50 flat		B.C.	Dia	Power
	O.D.	7.80	9.6	-3.00
	O.S.	7.60	9.6	-3.00
Over Refraction	O.D.	+0.50 -0.50 X 075		20/15
	O.S.	-1.00 -0.75 X 105		20/15
Over K	O.D.	40.50 @ 170	40.00 @ 080	
	O.S.	41.75 @ 175	41.00 @ 085	

Average Cylinder found by Over K (flexure)

Average over K cylinder on K

-.30 diopters

Average over K cylinder .50 steep

-.38 diopters

Average over K cylinder .50 flat

-.33 diopters

Average Cylinders found by Over Refraction (residual astig.)

Average over refractive cylinder on K

-.30 diopters

Average over refractive cylinder .50 steep

-.31 diopters

Average over refractive cylinder .50 flat

-.31 diopters

Discussion: The purpose of this experiment was to see if the Boston Envision exhibited flexure and if so the characteristics of that flexure. In this study we found the Envision lens flexed very little, however we feel that if the Envision lens was designed to flex,(thinner center thickness),the lens would flex more. On average the steeper fit flexed more than the flat fit, and the flat fit flexed more than the on K fit. These caracteristics mimic the flexure characteristics of regular RGP lenses. Having done such a small amount of subjects the results and averages appear very minute in differences. The amount of flexure exhibited was very slight due to the center thickness of the trial set used, much better results about the type of flexure that could be obtained with this lens can be studied by using a trial set with a thinner center thickness. If the highest and lowest measurements in cylinder that were obtained, were thrown out, the results changed very little. The best and most reliable measurments were obtained from the subjects that had worn RGP lenses in the past. In conclusion we feel that the aspheric design of the Boston Envision lens does not change the flexure characteristics from that of a regular RGP lens. This lens can be considered when flexure is desired, if the center thickness is decreased.