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A clinical evaluation of the performance of the GP-II contact lens

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Abstract

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A Clinical Evaluation of the Performance of the GP-II Contact Lens

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ABSTRACT

A clinical evaluation of the GP-II Contact Lens was made. Subjects were fitted with standard availability lenses and were subsequently monitored for a two month period. Of the twenty who started, twelve completed the study, thus 60% were successful. This study showed that corneal physiology was basically uncompromised within this experimental period. Variables considered were subjective symptoms, corneal health, lens centration and movement, pachometry, keratometry, and distance refraction.

INTRODUCTION

Corneal contact lenses made from polymethylmethacrylate have been the treatment of choice for many clinicians since their inception. There have been many different methods of fitting corneal lenses developed, and they are being used for a number of therapeutic regimens. No matter what the lens cornea relationship has been in fitting corneal contact lenses, some patients still cannot achieve safe, comfortable, full time wear. The practitioner must always be on the alert for signs of neovascularization, edema, corneal curvature changes, staining, and structural damage. Even in a successful, well fit case, the patient must be very careful to maintain a regular wearing schedule or risk the chances of developing a corneal insult with its possible consequences.

Flexible lenses have gained much popularity in recent years. This material is hydrophilic and flexible, contrasting with PMMA's rigidity and hydrophobic properties. They have less potential for corneal trauma because of their flexibility, and the adaptation period requires much less time than that of rigid lenses. Flexible lenses conform to the shape of the cornea and cover the limbus, therefore making it difficult for foreign bodies to get under the lens. Spectacle blur is often not a problem with flexible lenses, and comfortable wear is achieved almost immediately. Flexible lenses can be

worn irregularly, or part-time without causing significant adaptation problems.

The disadvantages of flexible lenses are their low tensile strength, affinity for proteinaceous deposits, and lack of stable optics. Visual acuity is not as good as with rigid lenses. Problems with corneal edema still exist as well as conjunctival reactions such as giant papillary conjuntivitis.

It is well established that one of the primary requisites for contact lens success is to provide sufficient oxygen to satisfy the basic respiratory needs of the cornea.[1] When the eye is open, the majority of oxygen utilized by the cornea is supplied through dissolution in the tears.[2]

Oxygen tension at the corneal surface is normally 155mm Hg. Polse and Mandell showed that oxygen tension as low as 11.4 to 19.0mm Hg was sufficient enough to prevent corneal edema.[3] The minimum corneal oxygen tension need varies between 2 and 5% depending on individual characteristics.[3,5] PMMA contact lenses usually supply between 1 and 3% oxygen at the corneal surface.[4] Therefore, a significant portion of the contact lens wearing population has a partial oxygen deficit at the corneal surface.

Studies by Korb[6,7] and others[8,9,10,11] have shown that the incidence of edema in the typical population of PMMA contact lens wearers is significant. Moderate or severe edema was present in 30% of the cases, enough to cause significant effects if longstanding.

For patients who are very sensitive to changes in oxygen supply to their corneas or who have irregular wearing schedules but cannot wear flexible lenses, the solution may lie in gas permeable rigid lenses.

Gas permeable rigid materials are similar only in that they transmit oxygen and other gases. The mechanism of gas permeability and the amount of oxygen transmissibility vary according to polymeric formation and center thickness. Among the most common materials in use today are: cellulose acetate butyrate (CAB), silicone, PMMA-silicone combinations, and PMMA-silicone-CAB combinations.

Thermal conductivity, i.e. the ability of a material to conduct heat of metabolism away from the corneal surface and thereby decreasing the nutritive requirements, enhances the physiological tolerance exhibited by these materials. Silicone has been measured to have about twice the thermal conductivity of CAB.[12]

Cellulose acetate butyrate is fabricated from naturally occuring materials; cellulose from wood and cotton, acetic acid from vinegar, and butyric acid from natural gas. The first published use of CAB as a contact lens material was by Stahl, Reich, and Ivani in 1974.[13] In addition to oxygen permeability, CAB has been shown to have a smaller wetting angle than conventional materials, thereby increasing the comfortability, especially in dry eye patients.[12] The major drawback of CAB lenses is the tendency of base curves to warp

upon hydration.[14] This material has "poor shape memory" and thus does not spring back when flexed or distorted.

The CAB contact lenses have been successfully prescribed without reports of corneal edema as a major problem.[11,15,16,17,18] Manufacturers are now trying new ways to improve their lenses to provide more comfort and less physiological insult.

The GP-II gas permeable lens is a newcomer to the contact lens field. The manufacturer claims this lens is unique in that it is made of CAB material which is subjected to new annealing process and chemical treatment that decreases the wetting angle. It is designed with the lowest wetting angle of all available rigid lenses--13.5°. As a result of this process, it is unknown as to the amount of modification that can be done without altering the wetting angle significantly. Because the GP-II lens is new with advanced design and manufacturing features and is available only in specific parameters, this study evaluated its performance and success on human subjects. Attention is given to resultant visual acuity, corneal thickness changes as measured with an electronic pachometer, and slit lamp observation for the incidences of edema, injection, and vascularizations. Subjective responses are also noted.

Since the wetting angle of the GP-II lens is one of its unique features, measurements were taken before and after varying types of modifications (using the Contact Angle Viewer by Kayeness Inc.) to determine if there are any changes.

METHODOLOGY

Fitting Procedures

This study consisted of thirty-eight eyes (nineteen subjects, ranging from 16 to 40 years). These subjects were randomly selected from a normal clinic patient population and included first time contact lens wearers and former soft contact lens wearers. All patients had refractive errors between +0.25 diopters and -5.75 diopters with no more than 2.75 diopters of refractive astigmatism. No patient had a corneal toricity greater than 2.50 diopters.

At the beginning of this study, each subject underwent a thorough eye health examination. The condition of the lids were checked along with the external and internal ocular tissues, to insure the absence of eye diseases or abnormalities. The central corneal thickness was measured using the Dicon Pachometer. In addition, each subject's refractive error was measured.

All three experimenters participated in fitting the subjects with GP-II diagnostic contact lenses. The best fitting contact lens for each patient was determined by analyzing the average keratometer readings and comparing them to the recommended GP-II fitting instructions. This initial diagnostic lens was placed on the subject's eye and twenty minutes were allowed for the patient to adapt to the lens. Then the lens performance was evalauted for centration, movement (immediately after the blink, the lens should be positioned midway between the inferior cornea and su-

perior limbus, after which it should make a quick movement to stabilize and center on the cornea), fluorescein dye pattern, subjective comfort, and vision through the lens with the appropriate overrefraction.

If the initial diagnostic lens failed to center or move properly, then a different diagnostic lens with the appropriate steeper or flatter base curve was selected until satisfactory performance was achieved.

Two different GP-II lens sizes, 8.8 mm and 9.2 mm, were employed in this study. Initially all subjects were fit with 9.2 mm lenses. However, if problems in centration and movement persisted despite changes in base curve, and the subject had a small vertical fissure width, then 8.8 mm diagnostic lenses were used.

The lenses were ordered only after the best fitting lenses were found, the correct power had been established, and it was predicted that the patient would achieve good vision and comfort with the lens.

Dispensing and Progress Examinations

Upon arrival of the lenses, they were soaked in Wet N' Soak for twenty-four hours and then verified. During dispensing visual acuities and an overrefraction were measured, and the lens was checked for centration, movement, fluorescein pattern, and subjective comfort. The subjects were instructed

in placement, removal and cleaning regimen. All patients were given the same solutions and instructions, (LC-65 for cleaning and Wet N' Soak for storing and wetting). They were told to follow the wearing schedule recommended by Hydrocurve:

Day	Hours
1	4
2	4
3	6
4	8
5	10
6	12
7 and after	all waking hours

One week after dispensing, each subject was seen for a progress examination. Any subjective symptoms were noted, another overrefraction and a complete biomicroscopic evaluation were performed. The cornea was inspected for edema, corneal stippling, any staining, lens centration, movement, and fluorescein dye pattern. The lens was removed and pachometry, keratometry, and distance subjective refraction were performed.

During the biomicroscopic evaluation, if the peripheral curve width was found to be less than 0.5 mm, the base curve-peripheral curve junction sharp, and the patient had subjective complaints, corneal edema or stippling, then the lens was appropriately modified to give it a 0.6 mm peripheral curve width, B blend, and a less sharp edge. Modifications were done with brass tools covered with dermacel tape, and brass tools covered with velveteen. A solution of XPAL and water was

used as the polishing agent. The radius tools chosen to widen the peripheral curve and increase the blend were found on a table, "CAB Finishing Curves" furnished by Hydrocurve.

Similar progress examinations were made again in one week, two weeks, and three weeks following the last progress exam.

Wetting Angle Measurements

In conjunction with the above, a wetting angle investigation was conducted before and after varying amounts of modifications normally done to a contact lens. The instrument used to measure the wetting angles was the Angle Viewer by Kayeness, Inc.

Before any modifications were performed, the wetting angles of four GP-II contact lenses were measured, first with the lens dry and then wet, with Wet N' Soak as the wetting agent. Saline was the test media.

The first lens with a base curve of 7.54 mm, was modified by increasing the blend by rotating it ten times each on radius tools 8.5 mm, 9.0 mm, and 9.5 mm, covered with velveteen moistened with a solution of XPAL and water.

The front surface of the second lens was polished by rotating it ten times on a 120° cone with moleskin suspended over it. The polishing agent was a solution of XPAL and water.

The edge of the third lens was modified using 60° and 90° cones with dermacel tape and velveteen covered drum tool. A one third-two thirds "ski-nose" edge was created.

The peripheral curve on the fourth lens with a base curve of 7.54 mm, was widened by 0.2 mm using a 12.00 mm radius tool. Peripheral curve radii and blend radii of the GP-II lenses can be found on the table "CAB Finishing Curves" furnished by Hydrocurve. The radius tool was covered with dermacel tape and moistened with a solution of XPAL and water.

Each modification was immediately followed by wetting angle measurements with the lens dry then wet with Wet N' Soak.

RESULTS AND DISCUSSION

Upon follow-up examinations, there was no observable edema nor any injection. In a few cases some low grade 3-9 staining was seen. For these subjects, the inside edge of the lens was modified and they were instructed to blink properly. One subject (I.M.) had bilateral moderate central corneal staining, noted on the first follow-up exam. However, this central staining was probably due to a reaction to the contact lens cleaning surfactant. The staining disappeared after the subject was told to rinse the lenses after cleaning.

An analysis of variance of repeated measures showed no significant changes in pachometry measurements of the central corneal thickness. The F values were significant at the .20 level thus assuring that the measurements were stable for the group during the two month period. (see fig. 1) Ophthalmometry values for the group were likewise stable during the experimental period.

The GP-II lenses did not produce large changes in refraction. They were found to have stabilized the post-refraction in two cases of previous PMMA wearers.

Upon dispensing, the visual acuity in each case was 20/20 or better for each eye. However, in some cases, by the fourth progress exam, the V.A. was found to be lowered in one eye. It was discovered that these same lenses were wetting poorly.

Two possible causes are a poor cleaning regimen and lack of enzyme treatments to remove deposits by subjects or instability of CAB material.

It was found that modifications such as widening the peripheral curve and blending did not alter the wetting angle when measured with the lens dry or wet (Wet N' Soak). However, edge and polishing modifications increased the wetting angle in each case, with the lens wet and dry. Therefore, the latter two modifications should be kept to a minimum and performed with care to prevent a large increase in the wetting angle.

Comparison of the wetting angle measurements between the lens dry and wet revealed that the angle is much lower when wet with Wet N' Soak.

Hydrocurve claims that GP-II's superior wettability is the key to patient comfort. Our findings suggest that a wetting agent is recommended to achieve the optimal wetting angle, especially after modifications are performed to the front surface and front edge of the lens.

RIGHT EYE

Source	SS	df	ms	F	P
Total	.0484	59	--	--	
Subjects	.0306	11	--	--	
Measures	-11.7550	4	-2.939	-10.98	.20
Error	11.7730	44	.2676	--	

LEFT EYE

Source	SS	df	ms	F	P
Total	.05642	59	--	--	
Subjects	.03795	11	--	--	
Measures	-12.083	4	-3.021	-11.29	.20
Error	12.101	44	0.2676		

Figure 1. Analysis of variance, repeated measures design, on central corneal thickness

(see page 10 for discussion)

MODIFICATION	ANGLE MEASURED
1. Control	37°
Rinsed with Wet-N-Soak	11°
2. Blending	37°
Rinsed with Wet-N-Soak	11°
3. Widening Peripheral Curves	37°
Rinsed with Wet-N-Soak	11°
4. Edging	69°
Rinsed with Wet-N-Soak	38°
5. Polishing Front Surface	77°
Rinsed with Wet-N-Soak	56°

Figure 2. Wetting Angle Measurements

Progress	Base	1	2	3	4
OD	.513	.516	.519	.525	.527
OS	.524	.526	.530	.537	.532

Figure 3. Pachometry Means

Progress	Base	1	2	3	4
OD	42.64	42.61	42.59	42.68	42.90
OS	42.81	42.82	42.54	42.71	42.88

Figure 4. Horizontal Keratometry Means

Progress	Base	1	2	3	4
OD	43.62	43.60	43.37	43.47	43.55
OS	43.72	43.61	43.63	43.68	43.64

Figure 5. Vertical Keratometry Means

Progress	Base	1	2	3	4
OD	1	2	4	2	3
OS	2	2	4	3	3

Figure 6. Corneal Staining Incidence Totals OD, OS

Progress	Base	1	2	3	4
OD	-1.81D	-1.85	-1.77	-1.89	-1.83
OS	-2.17D	-2.14	-1.94	-1.85	-1.77

Figure 7. Mean Sphere Values on Post-Refraction

CONCLUSION

In our experiments, 60% of the volunteers were able to wear the GP-II lens. All of the subjects who completed the study had less than two diopters of refractive cylinder and the four had no refractive cylinder.

There were six subjects who were discontinued for differing reasons. Patient M.U. was not included because the lenses did not arrive until the study was completed. Patient M.B. was discontinued from lack of compliance. In actuality, four patients could not tolerate the lenses for the following reasons:

1. Residual astigmatism (two subjects)
2. Excessive dryness and itching (one subject)
3. Fogging of the lenses (one subject)

The GP-II lens produced no corneal edema or corneal exhaustion. The gas permeable characteristics of this lens along with its increased wettability allows:

1. Larger lens diameters to be used which aid in lens centration,
2. Larger optic zone diameters to reduce glare, and
3. Steeper peripheral curves which aids in decreasing lid contact with the edge.

Although gas permeable lenses contribute to reduction of corneal symptoms and edema, one should not abuse that characteristic by fitting too tightly. The author's experi-

ence with hard gas permeable lenses shows that when the lens is too tight, there is a disturbance to the normal appearance of the cornea.

Lens flexure was minimal with the GP-II lens, but some flexing or warping should be expected with all CAB materials. This was a problem with early GP-II lenses bacause Hydrocurve sent the lens dehydrated. The problem was corrected when they were delivered hydrated in bottles.

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APPENDIX

PACHOMETRY

(Mean Values)

Patient		Baseline	Progress 1	Progress 2	Progress 3	Progress 4
S.H.	OD	.476	.496	.498	.491	.488
	OS	.482	.514	.503	.514	.505
H.K.	OD	.525	.504	.564	.561	.502
	OS	.585	.550	.582	.577	.533
D.K.	OD	.524	.529	.501	.560	.509
	OS	.520	.528	.529	.571	.530
W.K.	OD	.481	.507	.491	.467	.477
	OS	.483	.503	.504	.468	.476
R.K.	OD	.510	.525	.502	.540	.535
	OS	.515	.547	.532	.562	.563
E.M.	OD	.520	.560	.536	.527	.507
	OS	.552	.547	.546	.541	.513
J.M.	OD	.560	.537	.549	.575	.562
	OS	.546	.546	.560	.542	.563
R.M.	OD	.478	.443	.499	.472	.514
	OS	.476	.454	.508	.483	.551
R.M.	OD	.557	.508	.511	.553	.556
	OS	.561	.525	.547	.595	.580
I.M.	OD	.501	.540	.515	.498	.513
	OS	.525	.549	.525	.530	.528
K.W.	OD	.505	.500	.531	.504	.493
	OS	.528	.489	.510	.508	.498
B.W.	OD	.518	.553	.533	.553	.540
	OS	.512	.565	.521	.549	.544

HORIZONTAL "K"

Patient	Fitting	Progress 1	Progress 2	Progress 3	Progress 4
S.H.	OD 44.50	44.50	45.00	44.75	44.25
	OS 45.12	45.00	45.00	45.00	44.87
G.K.	OD 41.75	41.87	42.00	41.87	42.25
	OS 42.00	42.25	42.00	42.00	42.25
D.K.	OD 44.50	44.87	44.37	44.12	44.00
	OS 43.75	44.62	43.75	43.62	43.75
W.K.	OD 42.25	42.12	41.62	42.00	41.75
	OS 42.37	42.37	42.25	42.50	42.50
R.K.	OD 41.62	41.75	42.50	41.75	41.50
	OS 42.50	41.75	41.75	42.25	42.75
E.M.	OD 40.75	40.00	40.75	41.00	41.00
	OS 40.75	41.00	40.75	41.00	41.12
J.M.	OD 45.25	45.25	45.25	45.25	45.00
	OS 45.25	44.75	45.25	45.00	45.00
R.M.	OD 40.25	40.25	40.25	40.75	41.25
	OS 40.50	40.87	40.00	40.87	41.37
R.M.	OD 41.50	41.12	41.12	41.00	41.25
	OS 41.75	41.50	41.25	41.00	41.75
I.M.	OD 41.75	42.00	41.87	42.25	42.25
	OS 42.75	42.50	42.50	42.62	42.50
K.W.	OD 43.00	43.12	43.00	42.87	43.87
	OS 42.50	42.62	42.50	42.25	42.37
B.W.	OD 44.50	44.50	43.37	44.50	44.50
	OS 44.50	44.62	43.50	44.37	44.37

VERTICAL "K"

Patient	Fitting	Progress 1	Progress 2	Progress 3	Progress 4
S.H.	OD 45.62	45.25	45.50	45.75	45.62
	OS 46.25	46.25	46.00	46.25	46.25
G.K.	OD 42.75	42.62	42.62	42.50	42.37
	OS 42.75	42.62	43.12	43.00	42.37
D.K.	OD 44.50	44.87	44.75	44.12	44.25
	OS 43.87	44.00	43.87	44.00	44.00
W.K.	OD 43.50	43.37	42.62	43.25	43.00
	OS 43.37	43.50	43.00	43.37	43.00
R.K.	OD 43.25	43.75	43.37	43.75	44.25
	OS 43.75	44.50	45.37	44.75	44.50
E.M.	OD 41.25	41.50	40.87	41.62	41.25
	OS 41.37	41.50	41.25	41.25	41.75
J.M.	OD 45.75	45.87	45.50	45.37	45.37
	OS 45.75	45.37	45.62	45.50	45.37
R.M.	OD 41.50	41.75	42.12	41.25	42.62
	OS 42.25	42.12	41.87	42.00	42.37
R.M.	OD 41.50	41.00	41.37	41.25	41.25
	OS 42.00	41.25	41.50	41.25	41.50
I.M.	OD 44.12	43.37	43.00	43.12	43.25
	OS 43.75	43.50	43.25	43.12	43.62
K.W.	OD 44.25	44.12	43.75	43.75	44.12
	OS 44.25	43.75	43.75	44.00	43.87
B.W.	OD 45.50	45.62	45.00	45.87	45.25
	OS 45.25	45.00	45.00	45.62	45.12

CORNEAL STAINING (GRADE 1 - 4)

Patient	Baseline	Progress 1	Progress 2	Progress 3	Progress 4
S.H.	OD 0	0	0	0	0
	OS 1	0	0	0	3
E.K.	OD 0	0	0	0	0
	OS 0	0	0	0	0
D.K.	OD 1	0	0	0	0
	OS 1	0	0	0	0
W.K.	OD 0	1	0	0	0
	OS 0	1	0	0	0
R.K.	OD 0	1	0	0	0
	OS 0	0	0	0	0
E.M.	OD 0	0	1	0	1
	OS 0	0	1	0	1
J.M.	OD 0	0	0	1	0
	OS 0	0	0	1	1
R.M.	OD 0	0	1	0	0
	OS 0	0	1	0	0
R.M.	OD 0	0	0	0	0
	OS 0	0	0	0	0
I.M.	OD 0	0	2	1	1
	OS 0	1	2	1	1
K.W.	OD 0	0	0	0	1
	OS 0	0	0	1	0
B.W.	OD 0	0	1	0	0
	OS 0	0	1	0	0

POST REFRACTION

on (Cont.)

Patient	Baseline	Progress 1	Progress 2	Progress 3	Progress 4
S.H.	OD -2.50-.75X170	-2.50-.50X165	-2.75 sph	OD -2.50-.25X165	-2.50-.75X175
	OS -2.50-.25X030	-2.50-.50X175	-2.25-.50X175	OS -2.25-.25X180	-2.50-.25X015
E.K.	OD -1.25 sph	-1.25 sph	-1.50-.25X180	OD -1.50 sph	-2.00-.25X180
	OS -1.25-.25X180	-1.25 sph	-1.50-.25X003	OS -1.50 sph	-2.00 sph
D.K.	OD -2.00 sph	-2.75 sph	-2.50-.25X175	OD -2.50 sph	-1.75 sph
	OS -1.75-.25X080	-2.25-.25X155	-2.25-.25X025	OS -2.25-.25X175	-1.75 sph
W.K.	OD -1.50-1.25X180	-1.25-.75X175	-1.50-.50X180	OD -1.50-.75X175	-1.25-.75X004
	OS -1.50-1.25X020	-1.75-.75X020	-1.75-.75X035	OS -1.75-.75X035	-1.50-.75X046
R.K.	OD -2.50-1.00X010	-1.50-.50X010	-1.50 sph	OD -2.25-1.25X010	-2.25-1.00X010
	OS -3.75-1.00X150	-2.50-2.00X170	-1.75-1.00X175	OS -1.75-2.25X175	-2.00-2.50X180
G.M.	OD -1.50 sph	-2.00 sph	-1.50 sph	OD -1.25-.25X180	-1.25 sph
	OS -1.00-.50X090	-1.75 sph	-1.50 sph	OS -1.00-.25X075	-1.50-.50X090
J.M.	OD -2.00-.50X130	-2.25-.75X135	-2.25 sph	OD -2.50 sph	-2.00-.25X100
	OS -1.75-.50X063	-1.75-.50X076	-2.25-.25X025	OS -2.25-.25X075	-1.75-.25X070
R.M.	OD -2.00-1.75X020	-1.75 sph	-1.75-1.00X040	OD -2.25	-2.75-1.00X010
	OS -2.75-1.00X180	-2.75 sph	-2.25-.50X180	OS -2.50 sph	-2.25-.50X175
R.M.	OD -1.50 sph	-1.75 sph	-1.50 sph	OD -1.50 sph	-1.50 sph
	OS -1.75 sph	-2.00 sph	-1.75 sph	OS -1.75 sph	-1.75 sph
I.M.	OD -2.75-1.25X015	-3.00-.75X015	-2.25-1.00X015	OD -2.75-.75X015	-2.50-.50X005
	OS -5.75 sph	-5.00 sph	-4.25 sph	OS -3.75-.50X010	-2.75-1.00X180
K.W.	OD +.25-1.25X160	+.25-1.25X175	pl-1.00X170	OD pl-.75X180	pl-.75X165
	OS +.25-1.75X020	+.25-1.25X180	+.50-1.50X180	OS +.50-1.25X005	+.50-1.25X178
B.W.	OD -2.50-.25X150	-2.50 sph	-2.25-.50X175	OD -2.25-.25X005	-2.25 sph
	OS -2.50 sph	-2.50 sph	-2.25 sph	OS -2.00 sph	-2.00 sph

LENS SELECTION DATA

1. Patient: S.H. Age: 26 Sex: Female

Refraction: O.D. -2.50-1.75X170 20/15
O.S. -2.50-0.25X030 20/15
20/15 OU

Keratometry: O.D. 44.25/45.00@83
O.S. 44.62/45.50@090

		B.C.	Power	OAD	V.A.
C.L. ordered	O.D.	7.48	-2.75	9.2	20/15
	O.S.	7.48	-2.50	9.2	20/15

Pachometry:

	O.D.	O.S.
$\bar{x}$	.476	.482
sd	.020	.020
R	.056	.041
H	.501	.501
L	.446	.460

2. Patient: E.K. Age: 25 Sex: Female

Refraction: O.D. -1.25 sph 20/20
O.S. -1.25-0.25X180 20/20
20/20 OU

Keratometry: O.D. 41.50/42.50@78
O.S. 41.87/42.62@90

		B.C.	Power	OAD	V.A.
C.L. ordered	O.D.	7.85	-2.75	9.2	20/20
	O.S.	7.85	-3.00	9.2	20/20

Pachometry:

	O.D.	O.S.
$\bar{x}$	.525	.585
sd	.012	.014
R	.032	.030
H	.544	.603
L	.512	.572

3. Patient: D.K. Age: 22 Sex: Male

Refraction: O.D. -2.00 sph 20/20

O.S. -1.75-0.25X80 20/20

20/20 OU

Keratometry: O.D. 44.50 sph

O.S. 43.75/43.87@90

	B.C.	Power	OAD	V.A.
C.L. ordered	O.D. 7.42	-4.25	9.2	20/20
	O.S. 7.50	-3.50	9.2	20/15

Pachometry:

	O.D.	O.S.
$\bar{x}$	.524	.520
sd	.013	.019
R	.035	.042
H	.538	.537
L	.503	.494

4. Patient: W.K. Age: 23 Sex: Male

Refraction: O.D. -1.50-1.25X180 20/15

O.S. -1.50-1.25X20 20/15

20/15 OU

Keratometry: O.D. 42.25/43.75@92

O.S. 42.37/44.37@99

	B.C.	Power	OAD	V.A.
C.L. ordered	O.D. 7.94	-1.50	8.8	20/15
	O.S. 7.89	-1.75	8.8	20/15

Pachometry:

	O.D.	O.S.
$\bar{x}$	.481	.483
sd	.007	.004
R	.019	.011
H	.489	.487
L	.470	.477

5. Patient: R.K. Age: 30 Sex: Male

Refraction: O.D. -2.75-1.25X15 20/20
O.S. -3.50-1.25X165 20/20
20/20 OU

Keratometry: O.D. 41.62/43.25@90
O.S. 42.50/43.75@80

	B.C.	Power	OAD	V.A.
C.L. ordered	O.D. 7.82	-3.75	9.2	20/15
	O.S. 7.71	-4.25	9.2	20/15

Pachometry:

	O.D.	O.S.
$\bar{x}$	.510	.515
sd	.005	.017
R	.012	.048
H	.516	.548
L	.503	.493

6. Patient: E.M. Age: 25 Sex: Male

Refraction: O.D. -2.00 sph 20/15
O.S. -1.75-0.25X110 20/15
20/15 OU

Keratometry: O.D. 40.75/41.25@90
O.S. 40.75/41.37@92

	B.C.	Power	OAD	V.A.
C.L. ordered	O.D. 8.08	-3.00	8.8	20/20
	O.S. 8.08	-2.50	8.8	20/20

Pachometry:

	O.D.	O.S.
$\bar{x}$	.520	.552
sd	.011	.016
R	.030	.036
H	.535	.572
L	.505	.537

7. Patient: J.M. Age: 16 Sex: Male

Refraction: O.D. -2.00-0.50X130 20/15

O.S. -1.75-0.50X063 20/15

20/15 OU

Keratometry: O.D. 45.25/45.75@055

O.S. 45.25/45.75@090

		B.C.	Power	OAD	V.A.
C.L. ordered	O.D.	7.38	-2.50	8.8	20/15
	O.S.	7.38	-2.50	8.8	20/15

Pachometry:

	O.D.	O.S.
$\bar{x}$	.560	.546
sd	.015	.012
R	.048	.037
H	.582	.557
L	.533	.521

8. Patient: R.M. Age: 32 Sex: Male

Refraction: O.D. -2.00-1.75X20 20/20

O.S. -2.75-1.00X180 20/20

20/15 OU

Keratometry: O.D. 40.12/41.25@103

O.S. 40.37/41.87@84

		B.C.	Power	OAD	V.A.
C.L. ordered	O.D.	8.13	-3.25	9.2	20/20
	O.S.	8.13	-3.75	9.2	20/15

Pachometry:

	O.D.	O.S.
$\bar{x}$	.478	.476
sd	.010	.016
R	.024	.034
H	.489	.494
L	.465	.460

9. Patient: R.M. Age: 26 Sex: Male

Refraction: O.D. -1.50 sph 20/15

O.S. -1.75 sph 20/15

20/15 OU

Keratometry: O.D. 41.25 sph

O.S. 41.75/42.25@95

		B.C.	Power	OAD	V.A.
C.L. ordered	O.D.	8.02	-2.50	9.2	20/15
	O.S.	8.02	-2.75	9.2	20/15

Pachometry:

	O.D.	O.S.
$\bar{x}$	.557	.561
sd	.016	.012
R	.041	.039
H	.582	.588
L	.540	.548

10. Patient: I.M. Age: 40 Sex: Female

Refraction: O.D. -2.75-1.25X15 20/30

O.S. -5.75 sph 20/20

20/25 OU

Keratometry: O.D. 41.62/44.12@81

O.S. 42.62/43.62@81

		B.C.	Power	OAD	V.A.
C.L. ordered	O.D.	7.94	-3.25	9.2	20/15
	O.S.	7.96	-3.12	9.2	20/15

Pachometry:

	O.D.	O.S.
$\bar{x}$	.501	.525
sd	.007	.020
R	.019	.051
H	.510	.548
L	.491	.498

11. Patient: K.W. Age: 24 Sex: Female

Refraction:	O.D.	+.25-1.25X160		20/15	
	O.S.	+.25-1.75X20		20/15	
				20/15 OU	
Keratometry:	O.D.	42.87/44.12@79			
	O.S.	42.50/44.25@88			
		B.C.	Power	OAD	V.A.
C.L. ordered	O.D.	7.85	-0.75	9.2	20/20
	O:S.	7.85	-0.75	9.2	20/20

Pachometry:

	O.D.	O.S.
$\bar{x}$	.505	.528
sd	.005	.009
R	.014	.019
H	.512	.538
L	.498	.519

12. Patient: B.W. Age: 33 Sex: Female

Refraction:	O.D.	-2.25-0.25X150		20/20	
	O.S.	-2.25 sph		20/20	
				20/20 OU	
Keratometry:	O.D.	44.50/45.75@80			
	O.S.	44.37/45.50@105			
		B.C.	Power	OAD	V.A.
C.L. ordered	O.D.	7.42	-2.75	9.2	20/20
	O.S.	7.46	-3.00	9.2	20/20

Pachometry:

	O.D.	O.S.
$\bar{x}$	.518	.512
sd	.010	.013
R	.025	.028
H	.528	.530
L	.503	.501

13. Patient: M.U. Age: 32 Sex: Female

Refraction: O.D. -1.00-1.00X90 20/15
O.S. -1.00-1.00X80 20/15
20/15 OU

Keratometry: O.D. 45.04/44.79@95
O.S. 45.08/44.16@95

		B.C.	Power	OAD	V.A.
C.L. order	O.D.	7.46	-1.50	8.8	20/15
	O.S.	7.54	-1.50	8.8	20/15

Pachometry: N/A

Comments: The findings for this person are not included in the data because the ordered lenses did not arrive until after the study was completed.

14. Patient: M.B. Age: 33 Sex: Male

Refraction: O.D. -4.00-0.50X87 20/15
O.S. -3.00-1.25X130 20/15
20/15 OU

Keratometry: O.D. 44.50/45.00@90
O.S. 44.75/45.75@60

		B.C.	Power	OAD
C.L. ordered	O.D.	7.50	-4.50	9.2
	O.S.	7.42	-3.25	9.2

Pachometry:

	O.D.	O.S.
$\bar{x}$	.498	.513
sd	.011	.016
R	.038	.041
H	.516	.528
L	.486	.487

Comments: Halfway through the project, this patient was discontinued due to lack of compliance.

15. Patient: D.M. Age: 35 Sex: Female

Refraction: O.D. -0.25 sph 20/15
O.S. -0.50-0.25X015 20/15
20/15 OU

Keratometry: O.D. 45.00/45.50@90
O.S. 45.75/46.25@90

	B.C.	Power	OAD
C.L. ordered	O.D. 7.43	-0.50	8.8
	O.S. 7.34	-0.50	8.8

Pachometry;

	O.D.	O.S.
$\bar{x}$	.556	.552
sd	.011	.028
R	.033	.074
H	.575	.597
L	.542	.523

Comments: Patient dropped after two weeks because of time commitments and visual acuity problems. She was able to see 20/20+ during progress exams, but everything seemed to be constantly foggy. (cigarette smoker)

16. Patient: L.N. Age: 31 Sex: Male

Refraction: O.D. -1.25-0.25X45 20/15
O.S. -1.50 sph 20/15
20/15 OU

Keratometry: O.D. 44.30/45.80@74
O.S. 44.12/45.25@90

C.L. ordered: none

Pachometry: none

Comments: This patient was previously a spherical soft contact lens wearer with little or no refractory astigmatism, but a moderate amount of corneal astigmatism. When the patient was fit with diagnostic lenses, the over-refraction revealed residual astigmatism which decreased visual acuity.

17. Patient: L.S. Age: 27 Sex: Male

Refraction: O.D. -2.00-0.25X100 20/15
O.S. -2.25 sph 20/15
20/15 OU

Keratometry: O.D. 44.25/44.25@90
O.S. 43.75/44.50@90

	B.C.	Power	OAD
C.L. ordered	O.D. 7.44	-3.25	9.2
	O.S. 7.50	-3.25	9.2

Pachometry:

	O.D.	O.S.
$\bar{x}$	.557	.559
sd	.010	.009
R	.029	.027
H	.569	.572
L	.540	.546

Comments: Patient was unable to continue with research because of left lens discomfort. He experienced dryness, itching, lens awareness, spectacle blur, excessive blinking after six hours of wear.

18. Patient; G.M. Age: 39 Sex: Male

Refraction: O.D. -5.12-2.75X180 20/15
O.S. -5.62-1.25X170 20/15
20/15 OU

Keratometry: O.D. 42.25/44.25@82
O.S. 42.50/43.75@83

C.L. ordered: none

Pachometry: none

Comments: This patient has a higher amount of refractive astigmatism than corneal astigmatism, therefore the vision achieved through a spherical lens was not great enough for patient satisfaction. He was discontinued as a candidate for the study.