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The relationship between the size of a contact lens and the percentage of the corneal cylinder used with a toric base curve contact lens to provide an optimum fit

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Abstract

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The Relationship Between the Size of a Contact Lens and the Percentage of the Corneal Cylinder used with a Toric Base Curve Contact Lens to Provide an Optimum Fit

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of the Requirements for
the Degree of Doctor
of Optometry

by

Gary L. Mastolier
William D. Butler
Bruce J. Brewer

— CONTENTS —

— INTRODUCTION —

The toric base curve contact lens is relatively recent in the field of contact lenses, being introduced in 1950 by Noel Stimson.[1] Many practitioners prefer not to fit the more complex toric base curve lens possibly for three major reasons. Brungardt[2] reports that of 4,000 contact lenses he has fitted, only five percent of the corneas had sufficient toricity to require a toric base curve. Many forms of the conventional spherical contact lens can be prescribed for the majority of patients, thus reducing the demand for toric lenses.

Secondly, the induced cylindrical optical component is a problem with the toric base curve lens. It will be in the direction opposite to the corneal astigmatism, which then will most often be induced against-the-rule astigmatism and will be additive to the normally expected residual astigmatism of against-the-rule.[3] The magnitude of the induced astigmatism is approximately equal to one third of the cylinder of the lens when measured in air with a lensometer.[4] A bitoric lens is usually necessary to complete the fitting.

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[1] Robert B. Mandell, Contact Lens Practice: Basic and Advanced, Springfield, 1966, p. 330.

[2] Theodore P. Grosvenor, Contact Lens Theory and Practice, Chicago, 1963, p. 278.

[3] Ibid., p. 277.

[4] Louis J. Gerard, Corneal Contact Lenses, Saint Louis, 1964, p. 286.

The last factor is the problem of lens fabrication and verification. The present method of crimping the lenses to achieve the desired toric surface will have to be devised by the optical laboratories before the toric lenses will be completely accepted by the practitioners.[1]

The length of the fitting procedure of the toric base curve lens is approximately five times that of the conventional spherical lens.[2] Although the economic return is not of this magnitude, the potential self-satisfaction and benefit to the patient that otherwise could not be fitted with contact lenses justifies the time and effort involved in fitting the toric lenses. Many patients for the first time enjoy the benefits of fully corrected acuity, reduced aberrations and aniseikonia of the spectacle lenses, and improved binocular performance.

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[1]Dr. Sharp, Lecture at Pacific University, 1968.

[2]Grosvenor, p. 278.

— PURPOSE —

The purpose of this thesis is to determine if an optimum fit is a function of a relationship between the size and the percentage of the corneal cylinder used with the concave surface of a contact lens.

— REVIEW OF THE LITERATURE—

A toric base curve contact lens should be used with the toric cornea when a spherical base curve does not result in an optimum bearing relationship between the contact lens and the cornea. This was evidenced by an unacceptable fluorescein pattern of excessive pooling and bearing, poor lens centration, and excessive lens movement and rocking. Korb[1] reports that the lens-cornea bearing relationship must be evaluated in terms of the optical zone diameter of the lens, because the peripheral portion of the cornea is often more toric in the direction of with-the-rule.

To provide the uniform lens-cornea bearing relationship, the toric base curve must conform to the toric surface of the cornea and also permit the normal physiology of the cornea to be maintained. Because the toric lens design reduces rotation, rocking, and lag, the problems of venting are greater than for a spherical lens.

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[1] Donald R. Korb, "Corneal Contact Lenses with Toric Optical Zones and Spherical or Toric Peripheral Zones," Encyclopedia of Contact Lens Practice, Vol. II, 10th Supplement, Chapter IX, 5-15-61, p. 20.

[2] Mandell, p. 333.

Remba[1] suggests the flatter meridian of the base curve should be .25D flatter than the flattest corneal meridian. The steeper should also be flatter than the steepest corneal meridian, the proportion being approximately one-eighth the amount of the corneal toricity. The mean optical zone recommended was 7.5mm and the mean lens diameter was 8.8mm, or about 0.5 - 1.0mm smaller than a spherical contact lens.

Goldberg[2] suggests a larger diameter lens reduces the lens rotation and stabilizes meridional orientation. This requires a smaller optical zone diameter to produce adequate venting. Fenestration and truncation may also be necessary if the larger lens size is used.

Korb reports a summary of the toric base-curve lenses utilizing a trial lens method of fitting. In all cases, the flatter meridian of the base curve was flatter than the flattest corneal meridian by an average of 0.75D and an optical zone diameter of 7.5mm. The steeper meridian of the base curve was closer to the steepest corneal meridian, averaging 0.37mm flatter with a 7.5mm optical zone diameter. The amount of corneal toricity was not reflected consistently in the amount of toricity of the base curve. With-the-rule astigmatism required greater lens toricity on the average, while against-the-rule astigmatism required less lens toricity than was measured with the keratometer.

Baldwin and Schick[3] report that the minimum difference between the two meridians of the toric base curve should be 0.3mm for little or no rotation of the contact lens. Several guidelines are given for varying

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[1] Mandell, p.333.

[2] Ibid., p. 334.

[3] William R. Baldwin, and Charles R. Shick, Corneal Contact Lenses: Fitting Procedures, New York, 1962, p. 83.

from the most common toric base curve of two-thirds of the corneal toricity for the steeper meridian and on "K" for the flatter meridian. If the optical zone is fitted extremely small, the difference between the meridians of the toric base curve can be as great as the corneal toricity. If the corneal toricity is low, the meridional base curve difference may only be one-half of the corneal toricity, while the base curve difference for high corneal toricity may be as much as 80 per cent. If the optical zone diameter is to be large, the flatter meridian may be fitted flatter than "K"; but if it is to be small, the flatter curve may be fitted steeper than "K".

The overall diameter of the toric base curve lens should be less than the spherical lens since the bearing area is increased. Thus, the smaller the lens diameter, the closer the base curve meridians may parallel the cornea. If the lenses are small, the problems of venting are reduced. The peripheral curve is then usually thin and steep, and may not be necessary at all if the lens is fitted relatively flat on the base curve. Conversely, if the optical zone is large or the base curve is closely parallel to the cornea, the peripheral venting will have to be increased.

Grosvenor[1] states that the toric base curve lenses are generally small with a bevel or peripheral curve of an average of 0.4mm wide. The toric base curve is made to parallel the toric cornea if only the central keratometer readings are taken.[2] The toricity is based on the peripheral keratometer readings if these are taken.

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[1] Grosvenor, p. 269.

[2] Ibid.

Girard[1] recommends fitting the flatter meridian of the toric base curve parallel to the flattest corneal meridian and the steeper meridian steeper than the flattest corneal meridian by one quarter of the corneal toricity. A smaller lens diameter, not to exceed 8.5mm, is also recommended.

Haynes[2] illustrates the effect achieved theoretically by changing the lens size, but not the toric base curve or the percentage of the cornea fit by the toric lens. A diameter of 5.50mm and a toric base curve with the meridians parallel to the central keratometer readings should result in uniform minimal central clearance, which indicates a large uniform bearing zone. By increasing the total lens diameter to 9.0mm but retaining the same parallel toric base curve, the fluorescein pattern would change to distinct peripheral touch with apical clearance. The periphery of the lens is resting on the intermediate zones of the cornea because the peripheral toricity generally increases over that of the central toricity. The resultant poor venting could be changed by adding a toric peripheral curve, resulting in the contour principle of fitting.

Haynes[3] further states that in order to fit a large optical zone diameter, the fit will have to be correspondingly flat. The ideal bearing relationship will then be lost. Consequently a smaller optical zone diameter should be used for the toric base curve lens.

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[1]Louis J. Girard, Corneal Contact Lenses, Saint Louis, 1964, p. 286.

[2]Philip R. Haynes, Encyclopedia of Contact Lens Practice, Vol. II, 9th Supplement, Chapter IX, 3-15-61, p. 6.

[3]Ibid., p. 11.

Korb[1] states that a non-circular design lens is necessary for most toric base curve lenses in order to totally stop lens rotation. It is more critical with the more toric corneas with more than average lid pressure. Often the toric cornea also has a greater diameter difference with the vertical meridian being the shorter diameter.

Symptoms of a tight fit are of a greater proportion with toric base curves, possibly a result of little or no lens rotation to aid tear and heat exchange.[2] A perforation of the lens may be the best solution if the desired bearing relationship is achieved, but venting remains a problem. Factors that affect the rotation of the lens are the actions of the lids, the toricity of the cornea, the base curves used, the lens thickness, the overall diameter of the lens, and the shape of the lens.[3] Korb[4] reports the best success was achieved when a small circular optical zone diameter was used. This is achieved by using a toric peripheral curve oppostie that of the toric base curve.

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[1]Korb, p. 41.

[2]Ibid., p. 45.

[3]Ibid., p. 47.

[4]Donald R. Korb, "A Preliminary Report of Continuing Performance of Toric Inner Surface Contact Lenses", Contacto, Vol. 5, #10, Oct. 1961, P. 319.

— METHOD —

The patients for the thesis were screened for possible subjects on the following basis:

1. Minimum of two diopters of corneal cylinder.
2. Anticipated cooperation of the patient in the lengthy time needed for the study.
3. If possible, present contact lens patients would be preferred.
4. Motivation to wear contact lenses.
5. No contraindications to the wearing of contact lenses.

Three pairs of lenses with a diameter of 9.4mm were prescribed from the central keratometer readings and the subjective refraction for each patient. The flatter meridian of the toric base curve was made parallel to "K" and the steeper meridian of the base curve was varied from 60%, 70%, and 80% of the corneal cylinder for the three pairs of lenses.

The power of the subjective refraction in the flattest meridian of the corneal cylinder corrected for the corneal plane was incorporated in the flattest meridian of the base curve of the contact lens.

The peripheral curve was kept a constant on all lenses at 0.1mm width and 16mm radius. The blend was also a constant of 9.5mm radius and 0.1mm width, leaving the optical zone diameter constant in proportion to the size of the lens. The lens thickness was kept to the minimal thickness possible.

The 60% lens at the 9.4mm diameter was the first to be evaluated, followed by the 70% and 80% at the 9.4mm diameter. If it were determined that a reduction in size would improve any or all of the three pairs of lenses, the appropriate lenses were reduced in size by 0.5mm. The same peripheral curves and blends were re-established on the lenses. In addition, anterior bevels were added in a standard manner. A 60 degree fine stone was applied to reduce the edge thickness to just short of a knife edge, followed by the 90 degree stone for a transitional curve between the 60 degree and the convex curve of the contact. If the lens was of significant minus power, additional curves were applied with the inverted cones by adding an additional ten degrees per diopter of minus to a maximum of 120 degrees for a minus four diopter lens or greater.

The 60%, 70%, and 80% lenses at a size of 8.9mm were then evaluated. If needed, the size was again reduced by 0.5mm to 8.3mm, which was the smallest size used in the study. The minimum time the lenses should be worn before the lens fit was evaluated was set at four hours.

The criteria used to evaluate the fit was as follows:

1. Subjective symptoms.
2. Lens position, lag, and rotation.
3. Refraction.
4. Acuities, with and without the refraction.
5. Fluorescein pattern.
6. Keratometry.
7. Slit lamp evaluation of both the fit of the lens and of the effect of the fit on the physiology of the cornea.

Lens position was recorded in the vertical direction utilizing a number system of one to five and in the horizontal direction by a letter system of A to E. Number three was centered vertically, number one for a superior limbal touch, and number five for an inferior limbal touch. Letter A was used to record a limbal touch at 180° and letter E for a limbal touch at 0°.

— DISCUSSION —

Eight subjects were used for the study. Subjects one, six, seven, and eight did not wear contacts prior to the study. The remaining subjects were unsuccessful or semi-successful in the wearing of contact lenses. The subjective refraction and central keratometric findings used for the determination of the original lens prescription are shown in figure one.

— FIGURE 1 —

	Keratometer Readings	Corneal Cylinder	Subjective
1.	O.D. 42.25/44.75 at 76	2.50D	-0.25 -3.25 X165
	O.S. 41.87/44.62 at 86	2.75D	+0.25 -3.50 X172
2.	O.D. 40.00/44.50 at 74	4.50D	+1.25 -5.00 X160
	O.S. 39.75/43.75 at 104	4.00D	+2.00 -4.75 X017
3.	O.D. 40.62/44.62 at 88	4.00D	+1.75 -2.75 X003
	O.S. 40.37/46.12 at 85	5.75D	+1.75 -4.87 X177
4.	O.D. 42.25/44.87 at 98	2.62D	pl -1.75 X180
	O.S. 42.75/45.12 at 90	2.37D	+0.50 -2.00 X009
5.	O.D. 41.87/44.37 at 103	2.50D	-2.25 -3.00 X014
	O.S. 42.00/45.00 at 72	3.00D	-1.25 -3.50 X166
6.	O.D. 42.12/44.37 at 94	2.25D	
	O.S. 41.87/44.25 at 84	2.37D	
7.	O.D. 39.25/45.50 at 112	6.25D	+0.50 -1.75 X035
	O.S. 39.25/45.12 at 72	5.87D	-1.00 -1.75 X155
8.	O.D. 42.25/44.37 at 88	2.12D	-3.00 -1.75 X179
	O.S. 41.62/44.50 at 87	2.87D	-1.75 -3.50 X177

Subject one was female, characterized by slight exophthalmos, a palpebral aperature height of 12mm, and relatively little lid tension.

Subject two was female, with left unilateral exotropia and amblyopia of 20/100 in the left eye. Bilateral, rotary, nystagmus with periodic movement of the tropic eye suggesting a remnant of binocularity was in evidence before the fitting. After fitting with initial and all subsequent lenses, the objectively observed magnitude and percent of strabismus was reduced to approximately 20 percent. The subject's habits, corneal specifications, suitable lid tension, and extreme motivation all combined to warrant inclusion in the thesis despite the contraindications of the hyperopia, strabismus, and amblyopia.

Subject number three was a previous contact lens wearer who had not been examined in over five years and was having considerable difficulty in wearing contact lenses. The symptoms had gradually increased during the five months prior to acceptance as a thesis subject.

The biggest problem encountered with this subject was the extremely distorted corneas, especially on the right eye which had originally been fit with a spherical base curve lens. Both corneas were also observed to be lowered in sensitivity to pain. In fact, the left eye showed a 3mm circular abrasion located centrally on the cornea of which the patient was totally unaware.

After considerable difficulty was encountered in attempts to fit this subject with thesis lenses, it was decided to have the subject go without any contact lens wear for whatever time was required for keratometric findings to stabilize.

Spectacles were worn during the period of non-contact lens wear and corneal change required changing spectacle lenses twice to maintain acuity. Five weeks were required for stabilization of keratometric readings after which it was observed that keratometer mires were no longer distorted and corneal cylinder had increased from 1.50D to 4.00D on the left eye and from 3.62D to 5.75D on the right eye.

New contact lenses were ordered using the thesis criteria. Once again problems of fitting were encountered in that the patient had normally small palpebral fissures (7mm or less) and extremely tight lids. It was quickly observed that contact lenses would need to be very small and therefore, the 80% lenses were reduced to 7.9mm before a decent, comfortable fit was obtained. This put the lenses outside the criteria of the thesis and the patient was no longer considered part of the study. The patient is now increasing wearing time with the 80% thesis lenses at 7.9mm; no other lenses being wearable.

Subject four was male, wearing spherical lenses at the beginning of the study. Excessive lens movement and injection with prolonged wear was observed.

Subject five was female, wearing bitoric lenses originally. Acuity was reduced to 20/30 in the right eye and 20/25 in the left eye. The keratometer findings were flatter in the right eye by 1.12/0.37 at 100° and 1.50/0.50 at 90° in the left eye. Spectacle lenses were prescribed to allow the corneal meridians to stabalize and return to normal.

Subject six was a female who had small palpebral fissures and extremely tight lid tension. This subject was included in the study because of a lack of available subjects. This was an unfortunate choice, as these factors restricted the lens sizes and fitting evaluation. This subject was dropped from the study for these reasons.

Subject number seven was a female non-contact lens wearer with high corneal toricity of 6.25D on the right eye and 5.87D on the left eye. The subject was a binocular amblyope, having never enjoyed good acuity. Compounding the problem was a high esophoric pattern which was not observed in the beginning.

The refraction thru the first three pairs of thesis lenses (60, 70, 80%) indicated a need for an additional +6.00D which seemed to indicate that the lenses were either orienting 90° removed from proper orientation or that the powers as prescribed were placed along the wrong meridians. The lenses were re-verified and were determined to be correct as prescribed. Marking the lenses along the flattest meridian and observing the lens orientation verified the lenses were orienting correctly. New lenses were then prescribed with the newly found sphere value. Once again extreme blur was the major complaint and subjective refraction indicated a need for another +2.00D of sphere power.

As a result of insufficient plus correction which antagonized an already high esophoric pattern, the subject could not wear any of the thesis lenses so that wearing time and adaptation could be established while waiting for new lenses to be prescribed.

The third order of thesis lenses with +8.00 sphere power O.U. were only recently fit. Snellen acuity was improved from 20/40 to 20/30 with the lenses, but this did not make a subjective difference. All of the lenses were touching the inferior limbus, which was possibly a result of the plus prescription. This subject was dropped from the study because of insufficient time to cope with the problems encountered.

Subject eight was a male non-contact lens wearer. Only limited data was obtained because this subject proved unreliable, uncooperative, and was terminated.

The amount and distribution of the corneal cylinder of the individual subjects are shown in figure two. The majority of the corneal cylinder was between two and three diopters "with-the-rule". The range extended from 2.12D to 6.25D.

— FIGURE 2 —

Frequency					
1 O.D.					
4 O.S.					
5 O.D.	1 O.S.				
6 O.D.	4 O.D.				
6 O.S.	5 O.S.	2 O.S.		3 O.S.	
8 O.D.	8 O.S.	3 O.D.	2 O.D.	7 O.S.	7 O.D.
2.01-2.50,	2.51-3.00,	3.51 -4.00,	4.01-4.50,	5.51-6.00,	6.01-6.50

Corneal Cylinder

The lens that best fit the toricity of each cornea is given in the following table. The second and third best fits are also given when they are acceptable. The minimum amount of corneal curvature changes acceptable were 0.75D in either principle meridian. An acceptable fluorscein pattern could not include excessive pooling along the steeper meridian, inadequate venting, excessive tear layer thickness, or excessive lens touch.

— FIGURE 3 —

Comparison of Corneal Cylinder and Acceptably Fitting Lenses

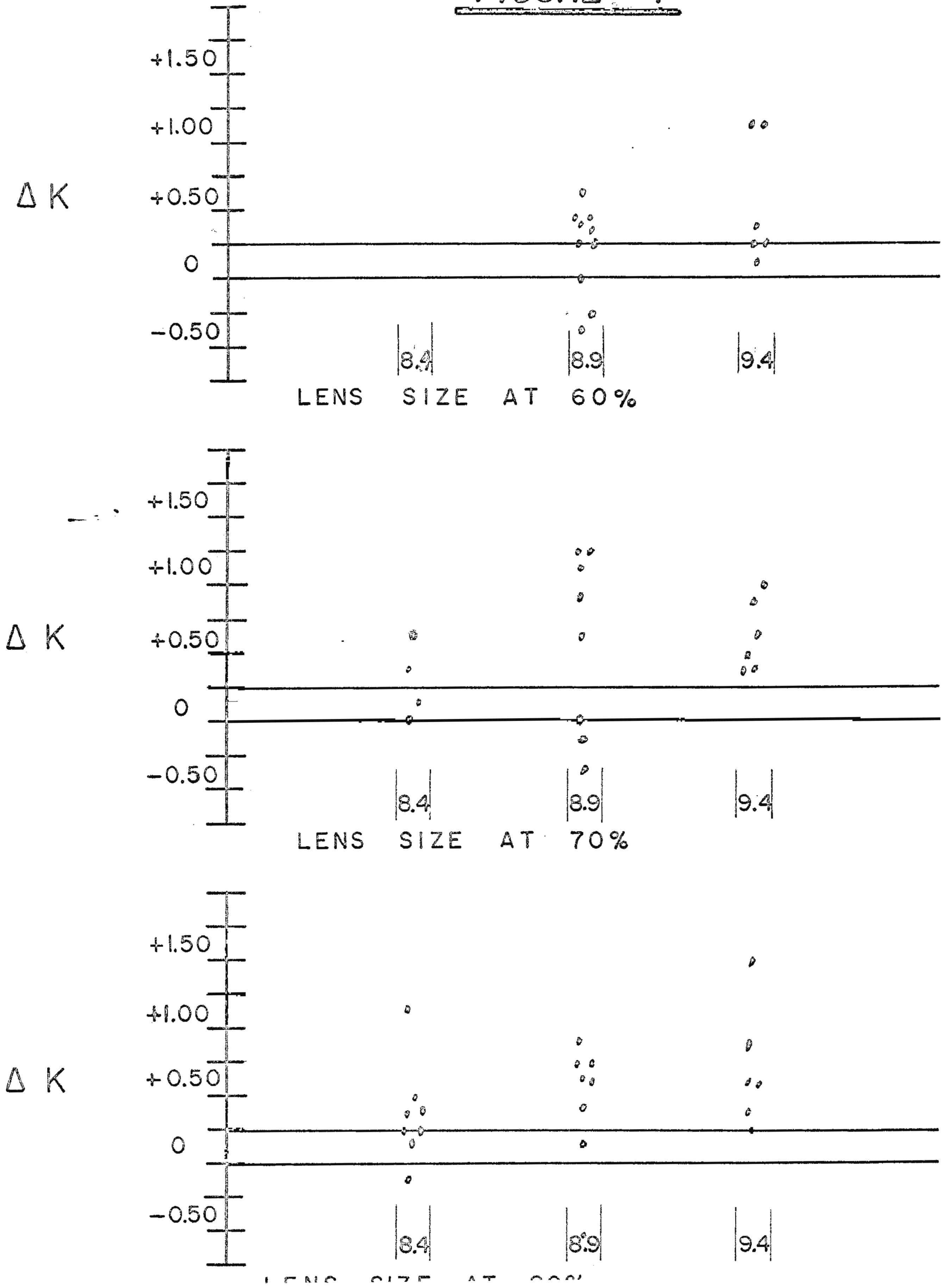
Corneal Cylinder of Each Subject		Best Fit	Second Best Fit	Third Best Fit
2.01-2.50				
	1 O.D.	60% at 8.9	60% at 9.4	70% at 8.4
	5 O.D.	60% at 8.9		
	4 O.S.	60% at 8.9	80% at 8.9	
2.51-3.00				
	1 O.S.	60% at 8.9	60% at 9.4	70% at 8.4
	5 O.S.	60% at 8.9		
	4 O.D.	60% at 8.9	80% at 8.9	
3.51-4.00				
	2 O.S.	70% at 8.4	70% at 8.9	80% at 8.4
	3 O.D.			
4.01-4.50				
	2 O.D.	70% at 8.4	70% at 8.9	80% at 8.4

One of the main fitting criteria is shown in figures four and five. This illustrates the relationship of the corneal curvature changes with the lens size and percentage. The 60 percent lenses with a size of 8.4mm are not shown as they proved to be unacceptable.

In figures four and five the plus values representing steepening of the corneal measurements. The minus values represent flattening of the corneal measurements relative to the original keratometer measurements. Figure four illustrates changes in the flattest corneal meridian. Figure five illustrates changes in the steepest corneal meridian.

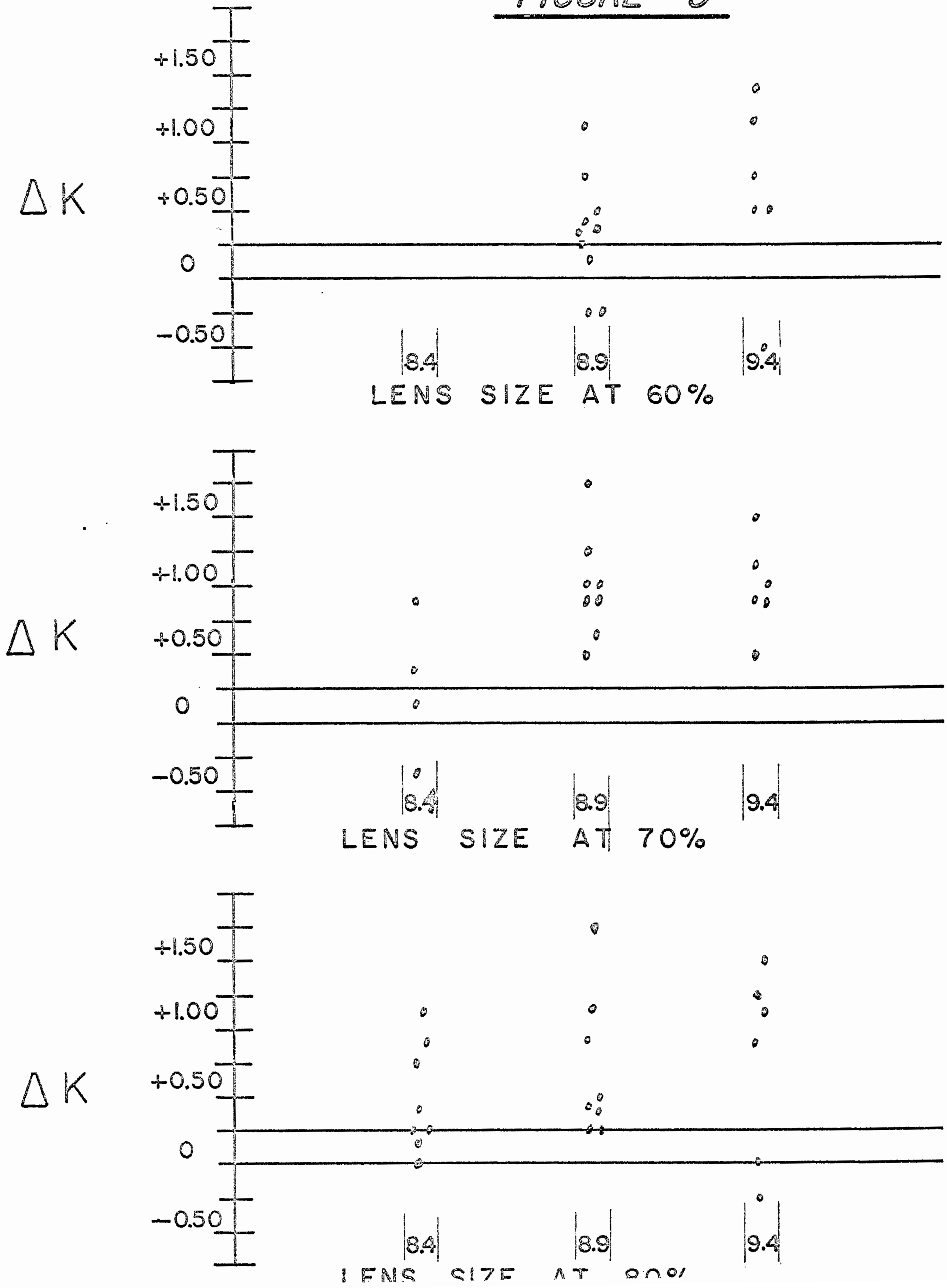
CHANGE IN FLATTEST CORNEAL MERIDIAN (Δ K) AS A FUNCTION OF LENS SIZE AND PERCENTAGE

FIGURE 4



CHANGE IN STEEPEST CORNEAL MERIDIAN (ΔK) AS A FUNCTION OF LENS SIZE AND PERCENTAGE

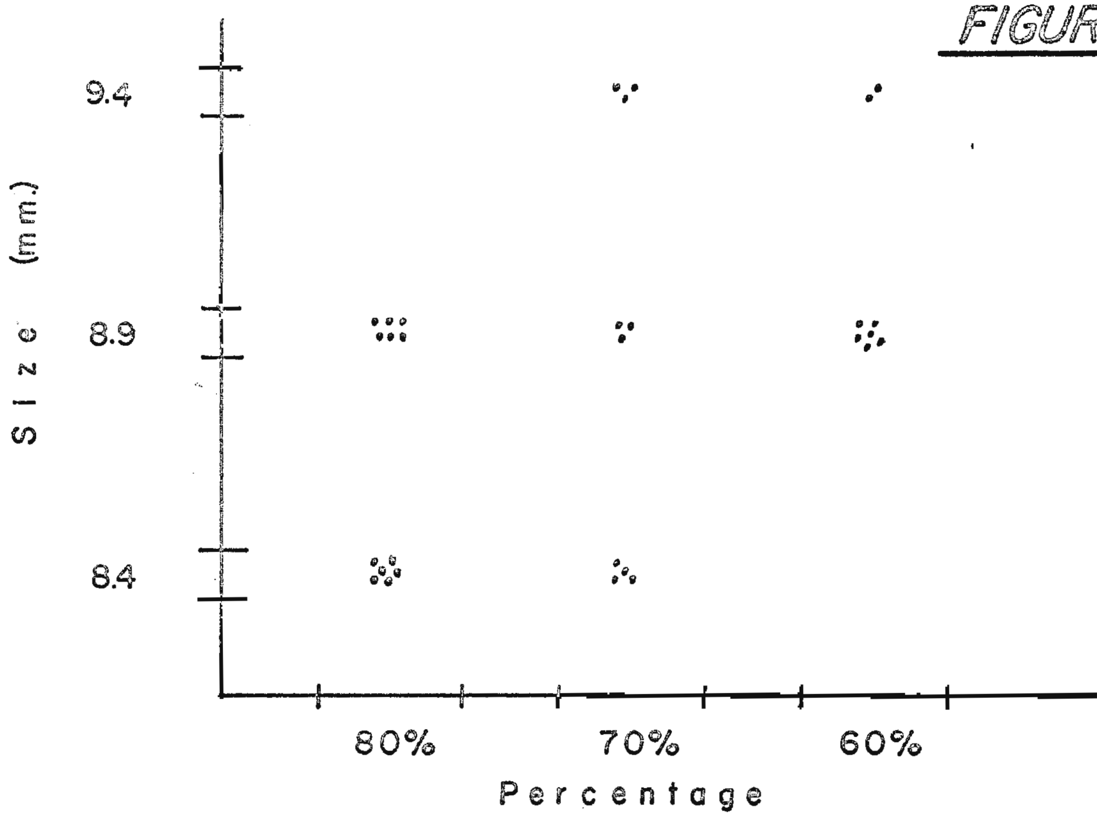
FIGURE 5



Comparison of the size and percentage of the acceptable lenses is shown in figure six. In contrast, the resultant subjective cylinder is given for all lenses in figure seven. The resultant cylinder should be prescribed for the convex surface of the lens, resulting in a bitoric lens design. A positive resultant cylinder indicates the induced cylinder from the toric base curve lens is in excess of the amount required, while the minus indicates an undercorrection.

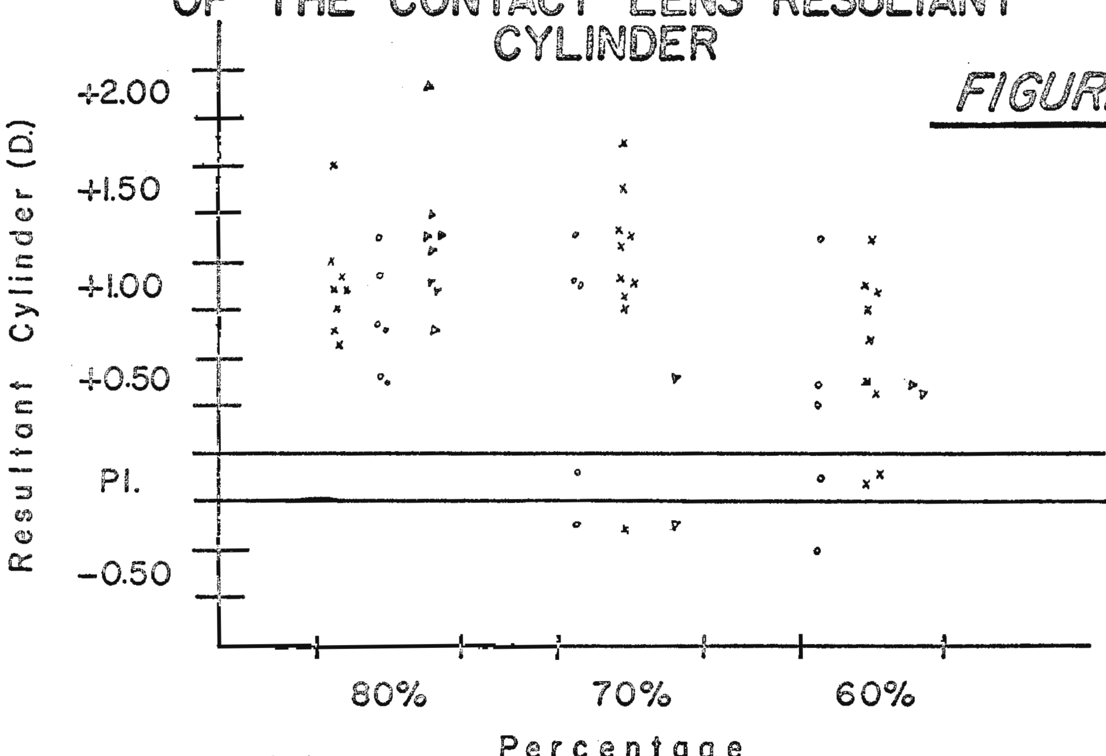
COMPARISON OF THE SIZE OF THE CONTACT LENS AND THE PERCENTAGE OF THE CORNEAL CYLINDER USED

FIGURE 6



COMPARISON OF THE SIZE AND PERCENTAGE OF THE CONTACT LENS RESULTANT CYLINDER

FIGURE 7



Key: ∘ = 9.4
× = 8.9
△ = 8.4

— CONCLUSION —

The 60 percent lenses at a size of 8.9mm were the optimum fits for corneal cylinder of two to three diopters. For corneal cylinder greater than three diopters, the 70 percent lenses at an 8.4mm diameter were necessary to achieve an optimum fit. The general trend for the second best fits were also 8.9mm in diameter with no apparent percentage preference. The third best fits tended to show smaller lens diameters and higher percentages of corneal cylinder.

Both principle corneal meridians tended to steepen more with the 9.4mm and 8.9mm diameter lenses at all percentages. The principle corneal meridians were changed least with the 8.4mm diameter lenses. The 60 percent lenses produced the least corneal change at 8.9mm. The 70 percent and 80 percent produced the least corneal change at 8.4mm.

There was a significant relationship between the size and percentage of the lenses. The rank-correlation coefficient was +0.525 utilizing the bracket method of ranking in tie situations and +0.56 using the mid-rank method of averaging the tieing ranks.[1] The tabulated rank-correlation coefficient for the five percent level of confidence is +0.364.[2] The null hypothesis of independence between the size and percentage of the lenses is rejected. This concludes that there is a relationship between the variables. In comparison the calculated value of t is 3.27[3], which is compared to the tabu-

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[1] Herbert Arkin, Statistical Methods, 4th ed, revised, New York, 1959, p. 86.

[2] Robert K. Young, Introductory Statistics for the Behavioral Sciences, New York, 1965, p. 421.

[3] Arkin, p. 210

lated value of 2.05 for the five percent conficence level.[1]

The 60 percent lenses generally resulted in less residual cylinder. The residual cylinder for the 70 percent lenses varied more, but generally was greater than the 60 percent and 80 percent lenses. There was little variance of the residual cylinder for the 80 percent lenses. The residual cylinder for the 8.4mm lenses at 80 percent was slightly greater than the larger lenses. This was not significant for the other percentage lenses.

— SUMMARY —

Toric base curve lenses of varying percentages and sizes were evaluated for eight subjects. Three subjects were dropped from the study.

The 60 percent lenses at 8.9mm diameter provided the best fit for moderate corneal cylinder. The 70 percent lenses at 8.4mm diameter were required for greater corneal cylinder.

Most lenses generally resulted in corneal steepening. The 8.4mm lenses generally resulted in the least corneal changes.

A significant relationship between the size and percentage of the lenses was shown. Larger lenses required a smaller percentage base curve.

The residual cylinder was less for the smaller percentage lenses and greater for the 70 percent lenses.

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[1] Ibid., p. 415.

AREAS FOR FURTHER STUDY

1. The analysis of the effect of the peripheral keratometer readings on the orientation of toric base curved contact lenses.
2. The photographic analysis of the fluorescein patterns.
3. The effect of changing the blend of the 60, 70, and 80 percent lenses at a standard size of 8.9mm on the fluorescein pattern and keratometer readings.
4. The continuation of our study using 70 and 80 percent of corneal cylinder and decreasing the lens size in 0.5mm steps to 7.2mm .
5. The effect of establishing peripheral curves for adequate venting of 60, 70, and 80 percent, 8.9mm toric base curve lenses.

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— APPENDICES —

(EXAMPLE OF RECORDING SHEET USED)

PAGE #__________

CONTACT LENS RECORD FOR: ______________________________ DATE: __________

LENS: OD ____________________ OS: ____________________ CLINICIAN: __________

SUBJECTIVE SYMPTOMS: ____

WEARING TIME: MAXIMUM: __________ TODAY: __________ DAYS WORN SINCE LAST VISIT: __________

LENS POSITIONING:

OD: 1 / 2 / A B 3 D E / 4 / 5 — LAG: __________ ROTATION: __________ FISSURE: __________

OS: 1 / 2 / A B 3 D E / 4 / 5 — LAG: __________ ROTATION: __________ FISSURE: __________

ACUITIES:	OD	OS	OU
Thru C.L.:	____	____	____
Thru Refr;	____	____	____

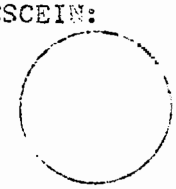
REFRACTION:

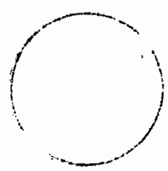
OD: ____________________

OS: ____________________

COMMENTS ON REFRACTION: ______________________________

FLUORESCEIN:

OD:  OZ: __________ BLEND: __________ PERIPHERY: __________

OS:  OZ: __________ BLEND: __________ PERIPHERY: __________

COMMENTS ON FLUORESCEIN: ______________________________

SLIT LAMP:

Without C.L.: OD: ____________________ OS: ____________________

With C.L.: OD: ____________________ OS: ____________________

COMMENTS ON SLIT LAMP: ______________________________

KERATOMETRY: INSTRUMENT:# __________

CONTACTOMETER:	TO ZERO READINGS ADD OR SUBTRACT:		ZEROED "K" READINGS:		CHANGE FROM ORIGINAL READINGS:
____	H:	V:	OD:	@	____
____	H:	V:		@	____
____	H:	V:	OS:	@	____
____	H:	V:		@	____

LENS CHANGES AND ADJUSTMENTS: ______________________________

SUBJECT 1			SYMPTOMS	POSITION	REFRACTION	FLUORESCEIN	SLIT LAMP	KERATOMETRY
9.4 mm.	60%	O D O S	NONE	#4 O U	pl. sphere +0.50 -0.37 X 25°	Slight ring Touch O U Uniform layer	Negative	0.25S / 0.62S 0.37S / 0.37S
	70%	O D O S	NONE	#4 O U	-0.25 -0.25 X180° +0.12 sphere	Uniform	Negative	0.25S / 0.75S 0.75S / 1.37S
	80%	O D O S	O S BLURRY	#4 #5	+0.25 -0.50 X 75° +0.50 -0.75 X 80°	Moderate Ring Touch	Slight Punctate Staining O U	0.50S / 0.75S 0.50S / 1.12S
8.9 mm.	60%	O D O S	NONE	#4.5	pl. sphere pl. sphere	Excellent	Slight Central Edema O U	0.25S / 0.25S 0.12S / 0.12S
	70%	O D O S	LID IRRITATION	#5 O U	pl. 0.25 X 5° +1.00 -0.75 X130°	Very Good Pattern	Negative	1.12S / 1.62S 1.12S / 1.12S
	80%	O D O S	VISION BLURRY	#4.5 O U	+0.25 -0.75 X 90° +0.75 -0.87 X 85°	Uniform	Negative	0.62S / 0.12S 0.50S / 0.25S
3.4 mm.	60%	O D O S	60%	L E N S E S W E R E N O T R E D U C E D T O 8.4 M M .				
	70%	O D O S	NONE	#4.5 O U	pl. -0.25 X180° +0.75 -0.50 X105°	Acceptable	Negative	0.25 / pl. pl. / 0.50F
	80%	O D O S	VISION BLURRY	#4 O U	+0.25 -0.50 X 45° +1.00 -1.25 X120°	Uniform	Negative	0.25S / pl. 0.37S / 0.12F

SUBJECT 2			SYMPTOMS	POSITION	REFRACTION	FLUORESCEIN	SLIT LAMP	KERATOMETRY
9.4 mm.	60%	O D	Lid sensation OU Hazy sensation OU After 7 hours wear glare	#5 C	pl. -0.37 X 80°	No peripheral	Slight Central Edema	pl. / 0.62F
		O S		#5 C	-0.50 -0.50 X 75°			0.12S / 0.37S
	70%	O D	No lid sensation Glare Nose running	#3 C	pl. -1.00 X 90°	Very even with slight S & I pooling; slight ring touch; sm. tear reserve	Negative	0.62S / 0.50S
		O S		#3 C	-0.50 -.25 X 60°			0.62S / 0.62S
	80%	O D	Lid sensation OU Headache; glare Burns after 2 hrs.	#2+C	-0.50 -0.87 X 50°	Even distribution Ring touch	Negative	0.37S / pl.
		O S		#2+C	+0.50 -0.50 X105°			pl. / 0.62F
8.9 mm.	60%	O D	No glare; lid sensation; inc. rotary nystagmus	#5 C	+0.25 -0.50 X 80°	OU Strong I pooling; OU strong touch at 180°	Negative	0.12F / 1.00S
		O S		#5 C	pl. -0.75 X 75°			0.12S / 0.37S
	70%	O D	Cannot feel the lenses; no glare	#5-C	+0.25 -1.00 X105°	Slight ring touch; Slight I pooling	Dye retention in several spots; improper cleaning	0.12S / 0.12F
		O S		#5-C	+0.75 -1.00 X 80°	More ring touch Slight I pooling		0.12F / 0.75S
	80%	O D	5 hours glare	#3 C	+0.25 -1.00 X 75°	Even distribution I & S pooling Slight OS ring touch	Negative	0.25S / 0.75S
		O S		#3 C	+0.50 -0.75 X 75°			0.62S / 0.12S
[illegible].4 mm.	60%	O D	No glare Lid sensation I scleral vascularization	#5 C	+0.25 -0.50 X 80°	Strong I pooling Apical touch at 180°	Negative	0.12S / 0.12F
		O S		#5 C	+0.25 -0.50 X 75°			0.12S / 0.25F
	70%	O D	No lid sensation Slight glare of the lights	#4 C	R. G. +0.50 +0.50 -1.00 X105°	Very even, good circulation I ring only	Negative	0.50S / 0.25S
		O S		#4 C	-0.75 -0.75 -0.25 X 80°			0.12F / 0.75S
	80%	O D	NONE	#4 D (poor)	+0.25 -1.00 X 75°	Even distribution Slight ring touch	Negative	pl. / 0.62S
		O S		#4 B (poor)	+0.50 -0.75 X 80°			0.12S / 0.25S

SUBJECT 3			SYMPTOMS	POSITION	REFRACTION	FLUORESCEIN	SLIT LAMP	KERATOMETRY
9.4 mm	60%	O D	Excessive tearing Pain; lid irritation OD & OS	#5	None Due To Pain	Apical touch, ring touch, pooling I & S, OD & OS	Negative	0 / 0.12S
		O S		#5	None Due To Pain	Same as OD		0.12S / 0.12S
	70%	O D						
		O S						
	80%	O D						
		O S						
8.9 mm	60%	O D	Feel scratchy; hurt, lid irritation, OD & OS	#5	+1.00 -1.25 X 90°	Apical touch; ring touch; extreme pooling, I & S, OD & OS	Negative	0 / 0.12S
		O S		#5	+1.75 -1.00 X 80°			0.12S / 0
	70%	O D	Excessive tearing Feel too large, OD & OS	#4	+1.00 -1.00 X 90°	Uniform bearing, Inf. pooling, Good, OD, OS.	Negative	0.12S / 0.12S
		O S		#4	+2.00 -1.50 X 90°			0.12S / 0.12S
	80%	O D						
		O S						
8.4 mm	60%	O D						
		O S						
	70%	O D						
		O S						
	80%	O D	Feel good, better than all previous lenses, OD, OS.	#4	+2.37 -2.00 X 90°	Apical clearance, ring touch, inf. pooling	Edema present Tears not venting	1.12S / 1.37S
		O S		#4	+2.37 -1.37 X 88°			2.00S / 1.87S

SUBJECT 4			SYMPTOMS	POSITION	REFRACTION	FLUORESCEIN	SLIT LAMP	KERATOMETRY
9.4 mm	60%	O D	None; both lenses feel good	#5 O U	+1.25 -1.25 X100°	S & I pooling, OD Good blend & periphery, OU; OS very good	Slight edema, OU Good tear layer, OU	1.00S / 1.00S
		O S			+0.25 -0.50 X145°			1.00S / 1.25S
	70%	O D	Both feel good; Monoc. Diplopia OU, w/o lenses Injection at 8 hr	#5 O U	+1.00 -1.25 X110°	Uniform O U Better pattern, O D	Slight edema, OU Uniform tear layer, O U	0.50S / 0.75S
		O S			+0.62 -1.00 X105°			0.87S / 1.00S
	80%	O D	None; lenses both feel good	#5 O U	+1.25 -1.25 X112°	Uniform, O U Slight ring touch, O U	Slight edema, OU	0.75S / 1.00S
		O S			+0.75 -1.00 X100°			1.37S / 1.37S
8.9 mm	60%	O D	None; both feel good	#5 B	+1.00 -1.00 X 88°	Inf. pooling, OU Temporal touch, O U	Negative, O U	0.25S / pl.
		O S		#5 D	+0.25 -0.75 X152°			0.25S / 0.12S
	70%	O D	None; both lenses feel good	#4 B	+1.00 -1.75 X 92°	Temporal touch, OU Good, O U	Negative, O U	1.00S / 0.37S
		O S		#4 D	pl. -1.25 X 95°			0.50S / 0.50S
	80%	O D	None; both lenses feel good	#5 B	+0.87 -1.62 X 90°	Temporal touch, OU Good pattern, O U	Negative, O U	0.75S / 0.25S
		O S		#5 D	pl. -1.12 X 95°			0.50S / 0.37S
8.4 mm	60%	O D						
		O S						
	70%	O D						
		O S						
	80%	O D	None; lenses feel good	#5 B	+0.75 -1.25 X 90°	Temporal touch, OU Good pattern, O U	Negative, O U	1.00S / 0.12S
		O S		#5 D	+0.50 -1.25 X 85°			0.25S / 0.12S

SUBJECT 5			SYMPTOMS	POSITION	REFRACTION	FLUORESCEIN	SLIT LAMP	KERATOMETRY
9-4 mm.	60%	O D	COULD					
		O S						
	70%	O D	NOT					
		O S						
	80%	O D	WEAR 9-4					
		O S						
8-9 mm.	60%	O D	WARM AT TIMES	#5	+0.75 -0.50 X112°	Temporal Touch O S	Negative	0.50F / 0.62S
		O S			pl. -0.87 X 105°	Fairly Even		0.37F / 0.25S
	70%	O D	FLARE	#5	+1.50 -0.87 X112°	Fairly Even O U	Negative	0.25F / 0.87S
		O S			+0.50 -1.25 X 93°			0.50F / 0.87S
	80%	O D	O S HOT	#5	+0.50 -1.00 X 90°	Even	Negative	pl./ 1.00S
		O S			+0.50 -1.00 X120°	Thin P Curve		0.75F / 1.62S
8-4 mm.	60%	O D						
		O D						
	70%	O D						
		O S						
	80%	O D	HOT O U	#5	+0.50 -1.00 X 75°	Thin and	Slight Edema	0.12S / 1.00S
		O S			+0.50 -1.25 X 83°	Even O U	O U	-0.25F / 0.25S

SUBJECT 7			SYMPTOMS	POSITION	REFRACTION	FLUORESCEIN	SLIT LAMP	KERATOMETRY
	60%	O D	Extreme blur; Extreme tearing, OD & OS	2 - B 2 - D	+6.00 -0.75 X 45^{0} +6.25 -0.75 X150^{0}	Vertical ellipse area of apical & peripheral touch, OD & OS	Negative	pl. / 0.12F pl. / 0.25S
9.4 mm	70%	O D O S						
	80%	O D O S	Same as 60% OD, OS.	Same as 60% OD, OS.	Could not re-fract to within ±2.00 D., OD & OS.	Same as 60% OD, OS.	Negative	Same as 60% OD, OS.
	60%	O D O S						
8.9 mm	70%	O D O S						
	80%	O D O S						
	60%	O D O S						
8.4 mm	70%	O D O S						
	80%	O D O S						

SUBJECT 8			SYMPTOMS	POSITION	REFRACTION	FLUORESCEIN	SLIT LAMP	KERATOMETRY
9.4 mm	60%	O D	Eyes get red. Reflection; No burning; hurt after 5 hours	#3 C	+1.25 -1.25 X 93°	I & S pooling with ring touch	Negative	0.25S / 0.12S
		O S		#3 C	+0.50 -0.25 X110°			0 / 0.37S
	70%	O D						
		O S						
	80%	O D						
		O S						
8.9 mm	60%	O D	Right eye feels like foreign body under the lens	#4 C	+0.75 -1.00 X 15°	OU even with slight inferior pooling and good P curve	Negative	0.50S / 0.37F
		O S		#4 C	+0.75 -0.75 X120°			0.12S / 0.37F
	70%	O D						
		O S						
	80%	O D						
		O S						
8.4 mm	60%	O D						
		O S						
	70%	O D						
		O S						
	80%	O D						
		O S						