MEASURED AND LABORATORY-STATED PARAMETERS OF THE GELFLEX MT

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Abstract

Twenty new Gelflex MT hydrophilic lenses were randomly selected from an optometry clinic for measurement of base curve radius and center thickness. Approximately 80% of the base curve specifications fell within acceptable limits, ±.2mm (0.2). 100% of the center thickness specifications were within suggested tolerence, ±.02mm.

INTRODUCTION

Most private practitioners are very limited in their ability to measure hydrophilic contact lens parameters. This is mainly due to inadequate instrumentation. Two important parameters which are often neglected are base curve radius and center thickness.

The exact center thickness is extremely important in that recent research has indicated the relationship between soft contact lens thickness and the amount of oxygen transmission, especially in the thinner lenses.[1]

Increased center thickness affects lens performance by making the lens less flexible.[2] The decrease in flexibility acts to "tighten" the lens. With standard thickness lenses such as Aquaflex, Hydron, AOSoft, and AL-47, the oxygen which the cornea needs is probable provided through lens pumping.[3] Any excess center thickness may cause poorer lens performance, tight symptoms, and more corneal swelling.

Base curve radius is one of the most important parameters of a hydrophilic contact lens but one of the most difficult to measure. A study by Schoessler and Barr (not yet published) indicated that the quality control of base curve radius of most soft lens manufacturers leaves much to be desired. The study indicated that the base curve radius is controlled very well for the Soflens and for the AL-47 lens, but not so well for the other lenses in the study (Hydrocurve II, AOsoft, Aquaflex, Hydron).

The Gelflex MT was used in this study because of its critical thickness (.06) and also because it was relatively new. A quality control study had not yet been reported.

METHODS

Center Thickness

The procedure used in this study was described by Paramore and Wechsler.[1] It is a simple technique which uses a standard radiuscope. An aluminum cylinder, which has been abraded over half the flat surface is placed over the lens holder. This set up allows easy measurement of the center thickness. A blotted lens is positioned so that the radiuscope mires fall half on the shiny side and half on the dull side. The instrument is then zeroed using the shiny side. The radiuscope is re-focused on the concave surface of the lens using the dull side. This measurement indicates the apparent center thickness. The actual center thickness is determined by multiplying the apparent center thickness by the index of refraction of the lens (1.43 for hydrophilic lenses). Data of the reliability and repeatability of this method used is listed in table 2.

Base Curve Radius

The base curve radius is one of the most difficult to measure accurately. Several methods have been reported. Table 1, taken from Barr and Lowther[4] summarize some of these methods.

Many of these methods are so inaccurate as to be useless, or require equipment that is not easily available, or are too time-consuming to be practical clinically.[4]

Two methods for measuring base curve radius were compared in this study. The first was using the commercially available soft lens analyzer. The soft lens analyzer involves comparing the fit of soft lenses with a series of templates of known radius. The comparison is made while the lens is in saline, by use of a projection technique. The reliability of this method is listed in table 2.

The second method involved use of the conventional radiuscope. A PMMA contact lens with a central fenestration of 5mm, base curve radius of 8.0mm, and a diameter of 12.5mm was mounted on a plastic cylinder 10mmx25mm which also had a fenestration of 5mm. The cylinder was then placed in a square, plastic, transparent cube 25mmx25mm. (See fig. 1) The chamber was then filled with saline solution and the lens placed concave surface up resting on the PMMA lens. Because the lens would have a saline interface when being measured a conversion factor would have to be used. To determine this factor 25 PMMA lenses of known base curve radius were measured with the above method. The conversion factor was found to be 1.336 which corresponds ~~approximately~~ to the index of refraction of the saline solution.

To make the measurement the setup described in Fig. 1 was mounted on the lens holder post of the radiuscope. With this setup 5 images are found as illustrated in Fig. 2. Since minus lenses were the only ones used in this study the 2nd and 4th images would be used to measure the base curve. The images used to measure the base curve are faint and are more easily located using the aperture reducer found on the AO radiuscope which is used to more accurately focus the mires. The reliability and repeatability of this method is shown in table 2.

CONDITIONS OF THE STUDY

Twenty new Gelflex MT lenses received by the contact lens clinic of Ferris State College were raddomly selected for the study. Each lens was coded so that the investigator inspecting the lens did not know which lens was being inspected. Three measurements of each method were made on two separate occasions for a total of six measurements for each method. The lenses were handled at all times with tweezers having soft plastic tip covers. The lenses had not been worn of remove from their vials before their removal for this study.

RESULTS

Table 3 shows the suggested tolerences of parameters of hydrophilic lenses (taken from an unpublished study by Schoessler and Barr). The mean center thickness measured was .067. The standard deviation was .007 and the range was .014.

Figure 4 shows the means of the base curve radius measured with the lens analyzer plotted against the laboratory specified base curve radius. The number of lenses measured, the equation for the best-fit straight line (solid line), and the line indicating a perfect correspondence between the measured and laboratory specified radius are also shown (dotted line). Figure 5 shows a similar graph using the radiuscope and Figure 6 shows a plot of the correlation between both methods used for measuring base curve. The correlation coeficients are also listed on each graph.

Table 4 gives the percentage of lenses whose specified base curves fell within different ranges of the measured values. For example 80% of the lenses measured fell within ±.2mm of the radius specified by the manufacturer.

ANALYSIS

100% of the lenses measured for center thickness were within suggested tolerance which is quite remarkable when compared with figures on center thickness from other studies. Table 5 is taken from a study done by Barr and Lowther which shows that many lenses measured were out of range of suggested tolerances.

The base curve as measured by thelens analyzer show fairly good correlation with 80% of the lenses falling within suggested tolerance. Although the correlation of the radiuscope method was near that of the lens analyzer method, the radiuscope method gave consistantly steeper readings than the lens analyzer method. Also the examiner noted that when measuring the lenses with the radiuscope method images were sometimes toric or badly distorted. While the lenses were being measured these findings were noted and upon repeated measurement it was found that the same lenses had toric of distorted mire images. This led us to believe that it was the surface quality of the lens responsible for the poor image rather than the measurement technique. An interesting study might be to compare the images in the radiuscope method to the images seen in the lensometer when power is being measured to see if there is any correlation between poor images seen in both methods.

When both methods were compared to each other (Fig. 6), it was found that they did not correlate well. This may be because of the scatter produced by the lenses with the poor image quality.

DISCUSSION

The technique used to measure center thickness was found to be easy to use and with good repeatability. It is an important parameter, especially with ultra thin lenses, and should not be overlooked.

The lens analyzer method of measuring base curve radius requires some practice in technique but after a short time gives adequate repeatable results. The problem with this method is that many practitioners consider the relatively high cost of this instrument an unnecessary luxury.

The radiuscope method is adequate using some lenses but is not with other lenses which apparently have poor surface quality. Another drawback is the larger diameter and thinner lenses tend to flex and give toric readings at times. Thicker lenses such as the AOsoft seem to be easier to measure. Another problem is the dimness of the image due to the small difference of index of refraction between the lens surface and the saline.

Since most contact lens practitioners already have a radiuscope this method would be ideal because of the low cost. But, because of the reasons listed above, this method needs more study and modification before it can be used with adequate confidence and reliability.

REFERENCES

1. Paramore, J. and S. Wechsler, Reliability and repeatability study of a technique for measuring the center thickness of a hydrogel lens, J. Am. Optom. Assoc. 49: 272-274, 1978.

2. Bier, N. and G. Lowther, Contact Lens Correction, Butterworths, London, 1977.

3. Efron, N. and L. Carney, Oxygen tension measurements under soft contact lenses with blinking, Intern. Contact Lens Clin. 6:250-254, 1979.

4. Barr, J. and G. Lowther, "Measured and Laboratory Stated Parameters of Hydrophilic Contact Lenses", Am. J. Optom. and Physiol. Optics 54:809-820, 1977.

Table 1

Methods reported in the literature for measuring the base curve of contact lenses-and the stated accuracies.

Method	Investigator	Stated Accuracy	Environment
1. Templates	Harris[1]	±0.30mm	Air
2. Wet-cell Radiuscope	Sohnges[2]	±0.10mm	Saline
3. Lens radius device	Sagan[3]	"less accurate than Radiuscope"	Saline
4. Microscope with auto-collimator	Bissell[4]	Not documented	Saline or other fluid
5. Micrometer(sag depth)	Dorman-Brailsford[5]	"accurate to 0.05mm"	Saline
6. Sohnges Kontr Mess system(projection)	Koetting[6]	±0.05 to±0.10mm	Saline
7. Projection	Loran[7]	±0.10mm	Saline
8. Zeiss ophthalmometer	Holden[8]	±0.02mm	Saline
9. Javal-Shiotz type keratometers	Chaston[9]	Not documented	Saline

Table 2

To determine the reliability of the investigative test methods 5 Gelflex MT lenses were measured 3 times on each of 3 days. The mean range and standard deviation are based on these 9 measures.

Laboratory Specification		Mean	Range	SD
Base Curve by Lens Analyzer(mm)	8.3	8.24	.1	.05
	8.6	8.67	.1	.05
	8.0	7.78	.1	.04
	8.6	8.88	.2	.08
	8.3	8.56	.2	.07
Base Curve by Radiuscope(mm)	8.3	8.31	.19	.08
	8.6	8.22	.16	.06
	8.0	7.70	.19	.07
	8.6	8.33	.19	.07
	8.3	8.35	.21	.08
Center thickness(mm)	.06	.065	.015	.008
	.06	.070	.015	.007
	.06	.070	.015	.007
	.06	.065	.015	.008
	.06	.065	.015	.008

Table 3

SUGGESTED STANDARD WET TOLERANCES (mm)

Base Curve Radius*	±0.20
Overall Diameter	±0.20
Center Thickness	±0.02
Power	±0.250

All measurements should be repeated at least three times.

* This tolerance may vary depending upon the material, its elasticity. thickness and water content.

Table 4

Percentage of Gelflex lenses found within different ranges when measured with the soft lens analyzer and compared to specified laboratory tolerances.

Radius	
≤ .1	42%
≤ .2	80%
.21→.3	5.3%
.31→.4	5.3%
.41→.5	5.3%
> .5	0%

Table 5

New hydrophilic contact lenses received in the optometry clinic at the Ohio State University were randomly selected for measurement. The sample consisted of 72 Bausch & Lomb Soflens contact lenses, 37 Milton Roy Naturvue lenses, and 22 Soft Lens Inc. Hydrocurve lenses. The percentage of each manufacturer's lenses whose specified dimensions fell within different ranges of the measured dimensions are tabulated for base-curve radius of curvature, power, center thickness, and overall diameter.

	Soflens	Naturvue	Hydrocurve
Radius(mm)			
<0.075	37.5	18.9	9.1
0.075-0.149	27.8	8.1	22.7
0. 150-0.224	20.8	24.3	31.8
0.225-0.299	6.9	0	31.8
0.300-0.374	4.2	8.1	9.1
0.375-0.449	0	13.5	9.1
0.450-0.524	1.4	0	4.5
0.525-0.599	1.4	8.1	0
≥0.06	0	18.9	4.5
Power(D)			
<0.120	30.6	35.1	45.5
0.120-0.249	34.7	32.4	31.8
0.250-0.369	19.4	21.6	13.6
0.370-0.499	8.3	10.8	4.5
≥0.500	6.9	0	4.5
Thickness(mm)			
<0.020	36.6	80.6	45.5
0.020-0.039	53.5	19.4	18.2
0.040-0.059	9.9	0	18.2
0.060-0.079	0	0	13.6
≥0.08	0	0	4.5
Diameter(mm)			
<0.20	85.9	51.4	59.1
0.20-0.39	14.1	18.9	31.8
0.40-0.59	0	16.2	9.1
≥0.60	0	13.5	0

Fig. 1

Setup for Radiuscope method of measuring base curve

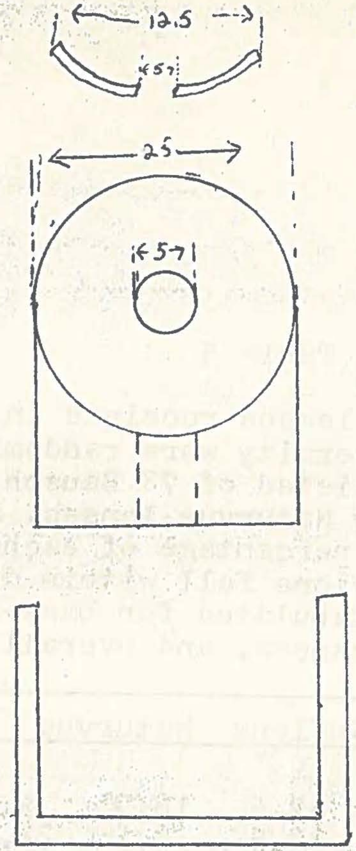
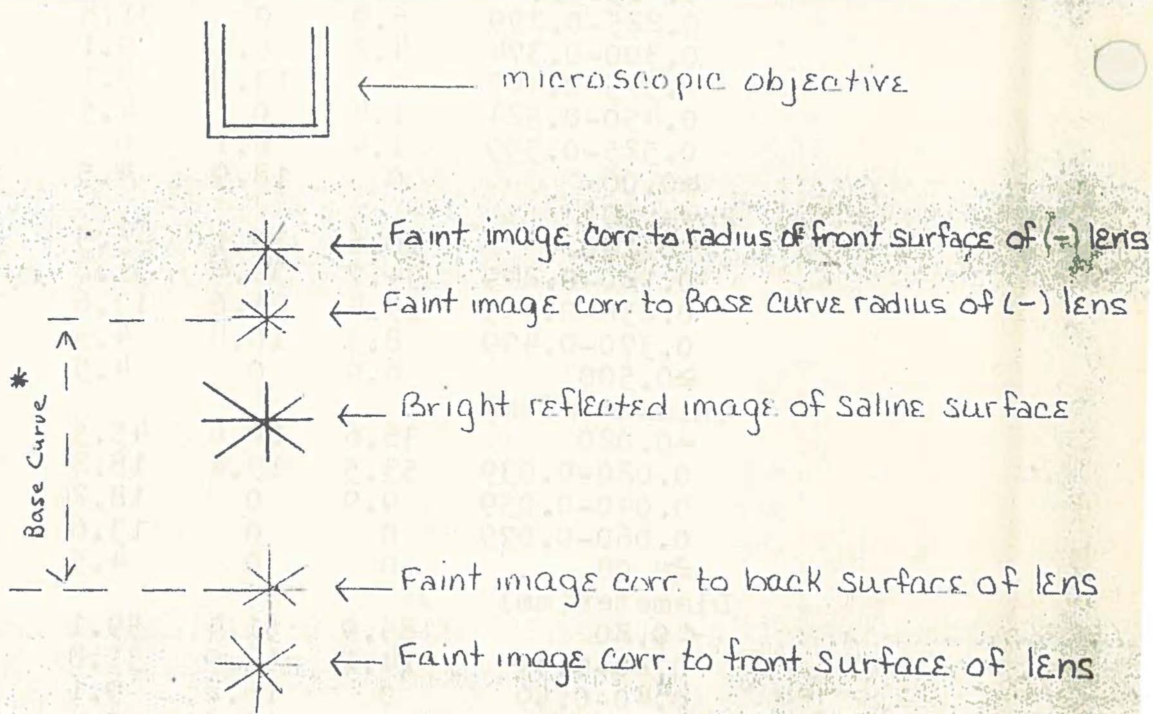


Fig. 2

Images seen when measuring base curve



* The measured base curve is multiplied by 1,336 to get the actual base curve.

Fig.4

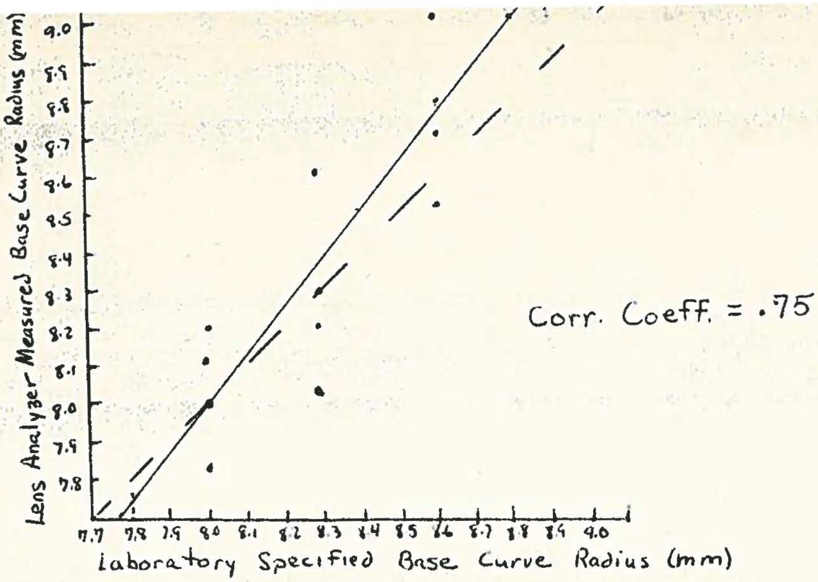


Fig.5

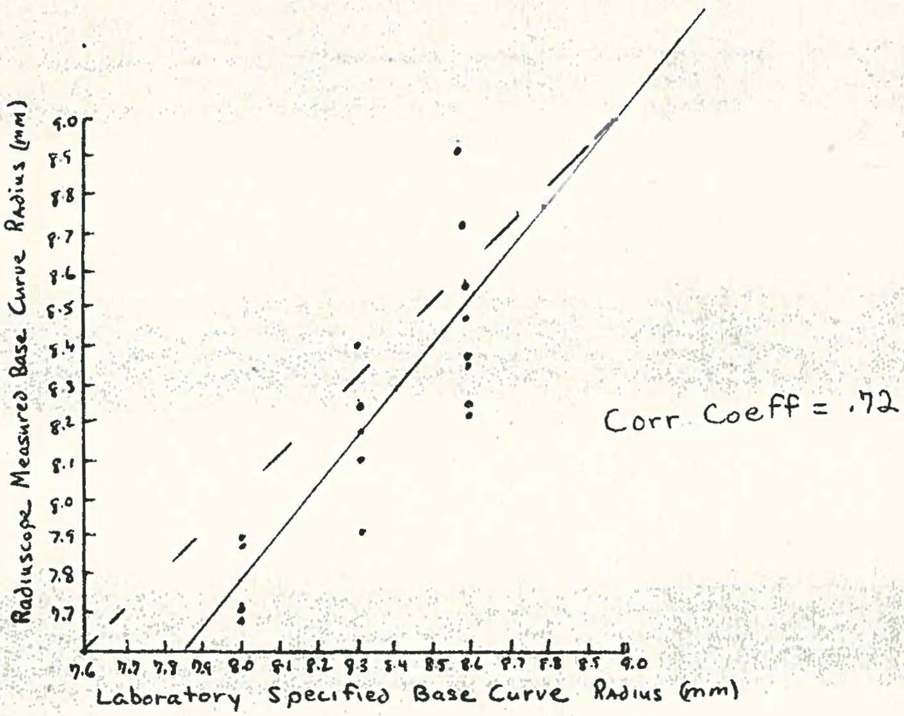


Fig.6