Reliability and Repeatability Study of the Tori-Check Measuring Device and Various Manufacturers of Toric Hydrogel Lenses

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April 4, 1989

Introduction

A frequent problem among eyecare professionals has been the accurate power measurement of a hydrogel contact lens.[2] The water content and nature of the lens material makes the traditional lensmeter measurement difficult. Other difficulties include poor handling, lens dehydration and finally draping the lens over a dirty lens stop in an attempt to obtain a reasonable approximation of the true power.[1,2]

A device called the Tori—Check was developed in 1986 by General Ophthalmics Inc.. The Tori—Check is primarily a lens holding and positioning device for power measurement of soft contact lenses. It is used to position spherical or toric lenses on the lens support of a lensmeter. Positioning of toric lenses includes rotational orientation for proper axis measurement. The device may also be used for holding soft lenses for inspection.[1]

The first goal of this report was to determine how consistant the Tori—Check device is at measuring contact lenses using various lensmeters. That is, what effect, if any, do stop distance variations and lensmeter designs affect Tori—Check's ability to accurately measure a lens.

The second goal of the study was to determine how closely the lens power and axis as measured with the aid of the Tori—Check compared to the parameters the manufacturer printed on the vial. "An informal poll of several contact lens educators, authors and lecturers recently showed that from 10 to as high as 35 percent of soft toric contact lenses are not as labeled (including problems with fit, power, axis or markings)."[1]

Methods and Results

I. Tori—Check Consistancy:

Seven lenses of varying power, material and manufacturer were used to determine the consistancy of Tori—Check using three different lensmeters. As can be seen from Table I, stop distance variances do not appear to have a significant impact on the power readings. The higher powered lenses show minimal yet consistant power variations. This shows that Tori—Checks ability to reliably and consistantly measure power is very good.

Table I

Power/Type of lens		Power read with lensmeter		
		Marco	AO	B+L
−13.00	Hydrogel	−12.75	−12.75	−12.75
+14.25	PMMA	+14.50	+14.50	+14.50
−7.50	RGP	−7.50	−7.50	−7.50
+8.00	RGP	+8.12	+7.87	+8.00
−0.75	RGP	−0.75	−0.75	−0.75
+0.50	RGP	+0.50	+0.50	+0.50
−18.00	Hydrogel	−17.25	−17.75	−17.75

General Ophthalmics recommends adjusting for a power measurement error when using the Tori–Check to measure the back vertex power of a lens. Their recommendations are as follows:

Reading	Add to reading
Plus Lenses:	
+5.00D to +9.00D	−0.25D
+9.00D to +12.00D	−0.50D
+12.00D to +15.00D	−0.75D
Minus Lenses:	
−7.00D to −11.00D	−0.25D
−11.00D to −15.00D	−0.50D

There is no appreciable error when measuring the front vertex power.

II. Measured versus Labelled parameters:

In order to determine how closely the actual power and axis of a toric hydrogel lens compared to the printed vial a set of tolerances had to be formulated. Three different toric lenses were measured using the Tori-Check and the same lensmeter. As can be seen from Table II each lens was measured five different times and seperate power and axis ranges were determined.

Table II

Power and Axis Ranges

	Lens #1	Lens #2	Lens #3
Trial #1	+.75-1.00x70	+2.25-2.25x99	+2.25-1.25x175
Trial #2	Pl-1.00x79	+2.25-2.00x100	+2.50-1.50x174
Trial #3	+.75-1.75x70	+2.00-1.75x100	+2.50-1.75x176
Trial #4	+1.00-2.00x67	+2.12-2.00x97	+2.50-2.00x173
Trial #5	+.12-1.12x68	+2.25-2.00x82	+2.50-1.25x180
Variability:	±1.00±1.00±12	±.25 ±.50 ±18	±.25 ±.75 ±7

Results: Tolerances

Sphere	=	±.50 Diopters
Cylinder	=	±.75 Diopters Axis
Axis	=	± 12 Degrees

The tolerances were determined by taking the high and low readings for sphere, cylinder and axis, and averaging the results. These tolerances will be used to help compare toric lenses made by different manufacturers.

Ten different toric lenses were randomly selected from each of three manufacturers. These were factory sealed vials from our clinic stock. The vials were covered so that prior to measurement the brand and power of each lens was unknown. Immediately after the lens was measured the results were recorded and the lens was assigned a corresponding code number until all thirty lenses were measured. The lenses were than uncovered and grouped according to manufacturer. When measuring the sphere power, cylinder power and axis, each lens was rotated to the base down position according to the lens markings. The results are given in Table III. As can be seen, the CIBA lens had the highest percentage of lenses that did not meet the specified tolerances. Hydrocurve II 55% water proved to fall within tolerances 100% of the time.

Table III

Printed Vial Comparisons

Manufacturer	Number of Lenses out of tolerance			Total # (%)
	Sphere	Cyl	Axis	
CIBA 38%	1	2	4	4 (40%)
Hydrocurve II 55%	0	0	0	0 (0%)
B+L Optima 55%	0	1	1	2 (20%)

Discussion and Conclusions

The Tori-Check works well as a handling and rotating device. The lens stays clean, dehydrates at an even rate resulting in improved image quality. Although improved, the image quality of the lensmeter mires are the limiting factor in determining the lens power.[2] No matter how dehydrated the lens, the image will never be crystal clear like it is with a hard lens or spectacle lens. This leads to relying on a bracketing technique to try and approximate the lens power. The large tolerance ranges determined earlier in this report reflect this fact. If one were to use a more widely used set of standard tolerances, such as the ANSI standards, than the percent of toric lenses failing to meet these tolerances rises dramatically. In fact, even the Hydrocurve II 55% lens would show a failing rate of 60%.

The toric lens comparison calculations revealed some interesting facts. The CIBA toric lens had the highest percent of lenses out of tolerance. This was due to the fact that they consistantly had the worst image quality. Considering they have the lowest water percent of the three brands tested, it would seem likely that the image quality would have been better. Surprisingly the lensmeter mires were the clearest with the Hydrocurve II 55% water lenses. Because of this the power could be more accurately determined and thus 100% of the lenses fell within my own set of tolerances. The Bausch and Lomb toric lenses fell right in between the other two brands with a 20% passing rate. The mire image quality of these lenses was also somewhere in between the other two brands.

Unfortunately I cannot assume that better mire quality infers better optics when the lens is worn on the eye.[3] That would have to be determined in another study. I can, however, conclude that due to the Hydrocurve II 55% lenses having the best mire quality, they allow for the most accurate measurement of power and axis of the three brands tested.

References

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