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## Comparison of predicted and actual over-refractions when using the Mastervue's RGP fitting recommendations

### Abstract

The use of computerized corneal videokeratography is one of the most exciting advances in the fitting of rigid contact lenses today. Traditional RGP fitting methods and our understanding of physiological and contact lens optics dictates that power should be determined by comparing lens base curve to the central three millimeter zone flat keratometric reading, and apply SAMFAP to compensate for lacrimal lens effects. This study addresses the issue that since the Mastervue lens fitting software selects lens base curve determined using a more peripheral corneal zone, clinically, how and where should lens power be determined? Twenty-eight subjects were fit with rigid gas permeable lenses generated by the Mastervue corneal topographer fitting software. Accurate monocular over-refractions were performed and compared to the predicted over-refractions determined using the simulated keratometric values at each the three millimeter and six millimeter corneal zones. From this data it can be shown which simulated keratometric readings should be used to determine the clinically most accurate contact lens power. The data showed that it did not matter which corneal zone SAMFAP is applied to when determining contact lens power. Through the interpretation of these results, it can be deduced that the Mastervue fitting software is effective in suggesting an initial RGP to be dispensed, however, trial fitting with an over-refraction is still the most accurate way of determining final lens power.

### Degree Type

Thesis

### Degree Name

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### Committee Chair

Jennifer Smythe

### Subject Categories

Optometry

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COMPARISON OF PREDICTED AND ACTUAL  
OVER-REFRACTIONS WHEN USING THE  
MASTERVUE'S RGP FITTING RECOMMENDATIONS

By

CURTIS P. DECHANT  
ROBERT W. EASTWOOD  
CHRIS D. THON

A thesis submitted to the faculty of the  
College of Optometry  
Pacific University  
Forest Grove, Oregon  
for the degree of  
Doctor of Optometry  
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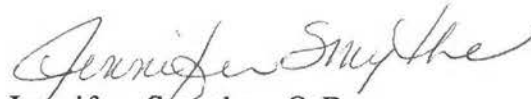


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**ABSTRACT:**

The use of computerized corneal videokeratography is one of the most exciting advances in the fitting of rigid contact lenses today. Traditional RGP fitting methods and our understanding of physiological and contact lens optics dictates that power should be determined by comparing lens base curve to the central three millimeter zone flat keratometric reading, and apply SAMFAP to compensate for lacrimal lens effects. This study addresses the issue that since the Mastervue lens fitting software selects lens base curve determined using a more peripheral corneal zone, clinically, how and where should lens power be determined?

Twenty-eight subjects were fit with rigid gas permeable lenses generated by the Mastervue corneal topographer fitting software. Accurate monocular over-refractions were performed and compared to the predicted over-refractions determined using the simulated keratometric values at each the three millimeter and six millimeter corneal zones. From this data it can be shown which simulated keratometric readings should be used to determine the clinically most accurate contact lens power.

The data showed that it did not matter which corneal zone SAMFAP is applied to when determining contact lens power. Through the interpretation of these results, it can be deduced that the Mastervue fitting software is effective in suggesting an initial RGP to be dispensed, however, trial fitting with an over-refraction is still the most accurate way of determining final lens power.

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## **KEY WORDS:**

Computer aided videokeratography, corneal topography, Mastervue Corneal Topographer, rigid gas permeable contact lenses

## **INTRODUCTION:**

Optometry is a rapidly expanding profession. Technology plays a critical role as practitioners strive to maximize efficiency of patient care. This technology has generated the rapidly expanding world of corneal topography.<sup>1</sup> The use of computerized corneal videokeratography is one of most exciting advances in the fitting of rigid contact lenses today. This technique uses contact lens fitting software designed by the manufacturer which takes the corneal curvature values, measured by the instrument, and uses these to calculate a contact lens back surface geometry to provide an optimum fit.<sup>2</sup> By taking many more data points on a cornea, computerized videokeratography allows for a better estimation of the base curve to cornea fitting relationship than does a simple numerical match of the posterior lens surface to the estimate of the anterior corneal curvature, as is done in the traditional keratometry method of fitting.<sup>3</sup> If accurate, this method of rigid lens selection would provide decreased fitting time, less dependence on trial fitting sets, and increased patient comfort with the ability to view fluorescein patterns on a computer screen<sup>1</sup>.

Since it is known that the cornea is asymmetric and progressively flattens in the periphery, when fitting rigid gas permeable lenses, current thought is that the emphasis should be directed toward the above mentioned peripheral parameters.<sup>4</sup> Through studies and practical experience it is understood that the area along the horizontal meridian, approximately three millimeter from center, is the most appropriate guide to establishing the desired mid-peripheral bearing zone along that meridian and in most cases of with-the-rule corneal astigmatism, permits unobstructed lens movement along the steeper meridian.<sup>5</sup> Associated with the cornea-contact lens fitting relationship is the determination of the appropriate lens power. Traditional RGP fitting methods and our understanding of physiological and contact lens optics dictates that power should be determined by comparing lens base curve to the central three millimeter flat K-reading and apply SAMFAP for lacrimal lens effects. If the lens base curve is selected by aligning the back surface with a radius of curvature approximately three millimeters or greater, temporally in comparison, to traditional methods of fitting based on central K-readings, clinically how and where should power be determined? The purpose of this study was to determine which simulated K-readings should be used to determine the clinically most accurate contact lens power. Investigators hypothesize that upon statistical analysis the power selected by the Mastervue corneal topographer is significantly more accurate towards that predicted at the three millimeter corneal zone versus the power predicted at the six millimeter zone. The hypothesis is accepted or rejected by comparing the predicted over-

refractions using the three and six millimeter keratometry values to the actual over-refractions obtained. Because the size of the pupil is a possible influence upon the individual visual acuity,<sup>6</sup> it could be hypothesized that a correlation may exist between accuracy of predicting over-refractions and pupil size.

## METHODS

28 subjects from the Pacific University student body were solicited under the agreement that custom rigid gas permeable lenses will be received following completion of the study at no expense to the subject. The subjects were screened for ocular pathology including corneal defects, and high astigmatic refractive error ( $>2.00$  D). The subjects were questioned regarding previous contact lens use, medications currently used, known allergies, past ocular disease, trauma, and/or surgeries. The study protocol was approved by the Pacific University Institutional Review Board, and written informed consent was obtained from each subject.

An accurate binocular subjective refraction resulting in the subject's best corrected visual acuity was performed. The spectacle prescription power obtained was then vertex distance corrected for the corneal plane. After the instillation of Refresh Plus lubricating drops one drop each eye, the Mastervue corneal topographer was used to measure corneal curvature on the subjects. The dioptric power values of corneal curvature were noted both at the 3 millimeter from center and 6 millimeter from center corneal zones. These keratometric values along with the aforementioned refractive correction at the corneal plane were entered into the Mastervue's contact lens fitting module. The fitting software determined the lens parameters, consisting of back vertex power, base curve, lens diameter, optical zone diameter, and peripheral curve specifications for each subject based upon this data. Rigid gas permeable lenses were produced by a reputable lens manufacturer to meet the above

specifications within ANSI standards. Upon receiving the lenses, the subjects were recalled. A brief reassessment of corneal integrity and general ocular health was performed along with assessing habitual visual acuity of each eye. One drop of topical anesthetic was administered to each eye of the subject followed by insertion of the hydrated rigid gas permeable lenses. An equilibration period of approximately ten minutes was allowed. At this time monocular spherical over refractions were performed using the best visual acuity obtained with the Bailey-Lovey chart as the precise end point. The luminance at the chart was 70 candelas/meters squared, with the contrast being 95% as measured by the Tektronix J-16 Photometer. The fit of the lenses were evaluated for centration, and for alignment using fluorescein dye. If adequate, subjects were offered the lenses for personal use to be dispensed at a later date through the Pacific University contact lens clinic.

Predicted over refractions at both the 3mm and 6mm corneal zones were determined empirically as suggested by Bennett and Grohe (Bennett and Grohe, 1986). The actual over refraction was performed monocularly by adding minus in quarter diopter steps until the patient was unable to identify additional letters accurately. This was compared to the predicted over refraction values to determine which corneal zone provided the most accurate prediction.

As an aside to this study, pupil size was measured in standard room illumination using the Allen Entoptic Pupillometer.<sup>6</sup> The pupil size

was compared to accuracy of predicted over refractions at both corneal zones.

## RESULTS

Using a One Factor Anova Repeated Measures statistical analysis of the data, it has been found that there exists statistically significant differences between the predicted over-refractions at both the three and six millimeter corneal zones, and the actual over-refractions obtained at the  $p = .05$  level. Figures 1-4 demonstrate this lack of consistency between over-refractions predicted and obtained. In addition, there was found to be no correlation between pupil size and accuracy of over-refractions for either the three or six millimeter corneal zone.

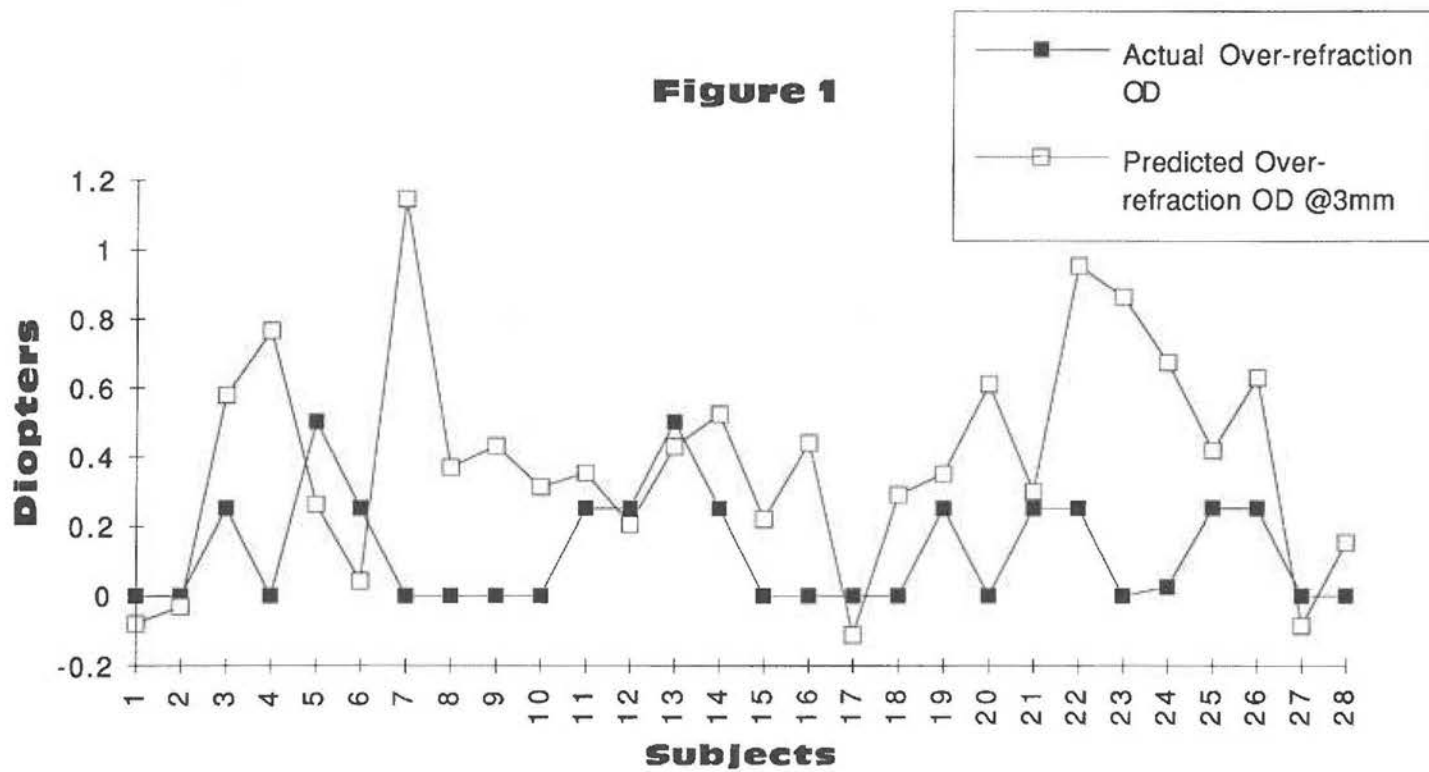
In an effort to determine if there is a clinically significant difference between actual and predicted over-refractions at either corneal zone, an analysis of the dioptric difference between actual and predicted over-refractions was performed considering a difference greater than or equal to  $\pm 0.25$  diopters as clinically significant. Tables I and II list the percentage of clinically significant differences and the percentage of differences greater than or equal to  $\pm 0.50$  diopters, respectively, for the three and six millimeter corneal zones. Both the three and the six millimeter zone were found to have a clinically significant difference between predicted and actual over-refractions in at least 50% of the cases.

Table III shows the percentage of over-refractions obtained that were greater than or equal to  $\pm 0.50$  diopters and the percentage

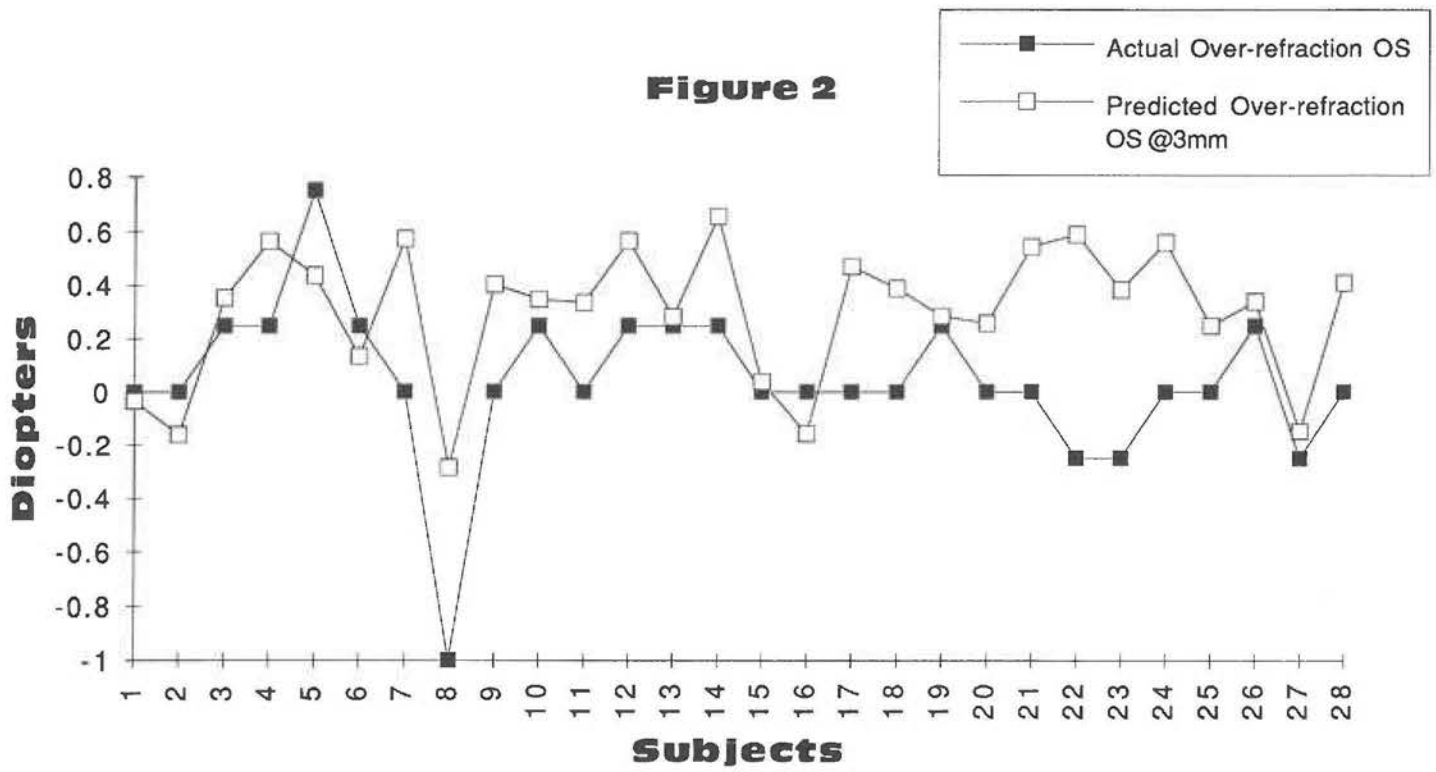
greater than or equal to  $\pm 0.25$  diopters, revealing that significantly less over-refractions were greater than or equal to  $\pm 0.50$  diopters.



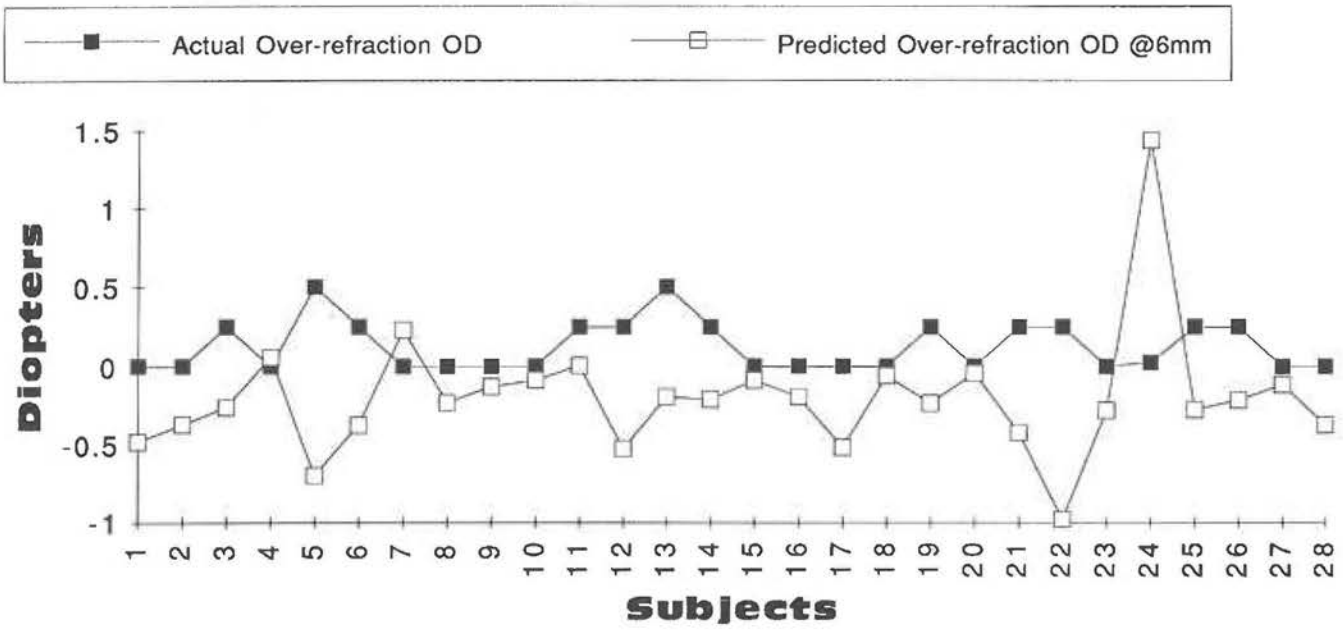
**Figure 1**



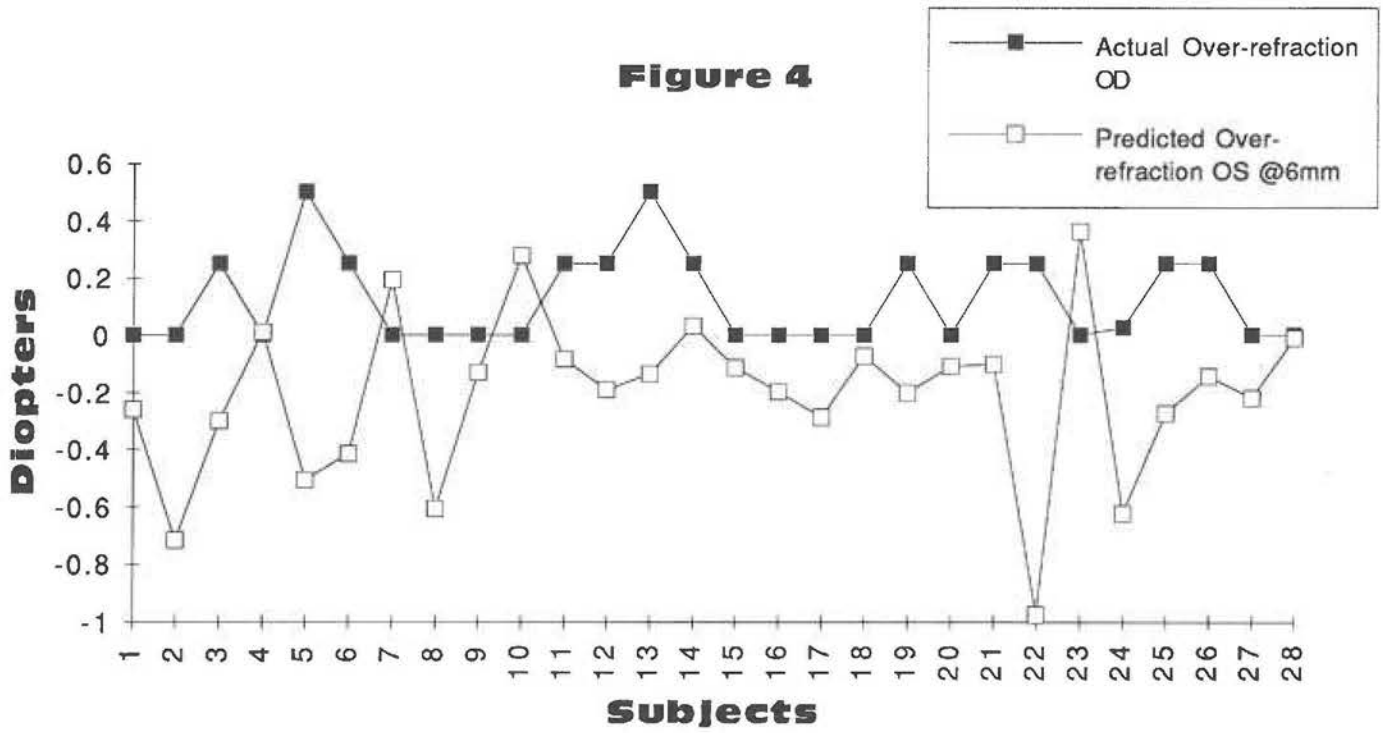
**Figure 2**



**Figure 3**



**Figure 4**



OD		OS	
3 mm zone	6 mm zone	3 mm zone	6 mm zone
50.0%	60.7%	60.7%	53.6%

**TABLE I:** Percentage of clinically significant dioptric differences between actual and predicted over-refractions per corneal zone considered.

OD		OS	
3 mm zone	6 mm zone	3 mm zone	6 mm zone
21.4%	35.7%	21.4%	25.0%

**TABLE II:** Percentage of dioptric differences between actual and predicted over-refractions greater than or equal to +/- 0.50 diopters.

Percentage of Over-Refractions +/- 0.50 D or Greater	Percentage of Over-Refractions +/- 0.25 D or Greater
7.1%	48.2%

**TABLE III:** Percentage of over-refractions obtained which are greater than or equal to +/-0.50 diopters and +/-0.25 diopters.

## DISCUSSION AND CONCLUSIONS

There exists a statistically significant difference between the predicted over refractions based upon corneal curvature measurements taken at both 1.5 millimeters temporal to center (three millimeter corneal zone) or three millimeters temporal to center (six millimeter corneal zone) and the result of the actual over-refractions. There was also a rather high incidence of clinically significant dioptric differences between our predicted values and the actual values obtained when taking either corneal zone into consideration.

This lack of predictability may be attributed to the subjective nature of the data collection. Factors such as patient over-accommodation through the contact lenses, although controlled as much as possible, may still influence results. Also, subjective interpretation of clarity and adaptation effects may play a role in the outcome of results. In addition, the lack of lens movement, lid interactions and flexure limits the clinical success rate when compared with the diagnostic fitting method.<sup>1</sup>

Through the interpretation of these results, it can be deduced that the Mastervue fitting software is very effective in suggesting a viable initial rigid gas permeable lens to be fit and dispensed. However predictions alone, based upon either the three or six millimeter corneal zones, of the actual lens power to order appear inadequate. To nullify all sources of error, it becomes obvious that

regardless of techniques used to predict lens power, it is in the best interest of the practitioner to actually place a lens upon the eye of the patient and perform an accurate over-refraction.

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