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The Effect of Specific Gravity on the Fitting Characteristics of Rigid Gas Permeable Lenses

ABSTRACT

Both center thickness and specific gravity play an integral role in the fit of a rigid gas permeable contact lens. A pilot study was organized to investigate the affects of center thickness and specific gravity on the fit of the fluorosilicone acrylate lenses, Fluoroperm 60 (specific gravity 1.15) and Boston RXD (specific gravity 1.28). Center thickness was varied in each lens (0.09, 0.12, 0.15, 0.18, 0.21). Results showed no significant difference in fit between the two lenses with change in center thickness.

INTRODUCTION

Center thickness is an important dimension of a rigid contact lens. An increase in thickness, (resulting in increased lens mass), can cause the lens to drop on the eye. In addition, a lens of higher specific gravity will cause a lens to ride lower than a lens of relatively lower specific gravity. The purpose of the study was to investigate the center thickness at the which the overall fit of both the Fluoroperm 60 and Boston RXD changed. In addition, a comparison was made between the lenses as to the extent of change noted for all five thicknesses.

METHODS AND MATERIALS

SUBJECT: Three subjects were used in the study. The study was conducted at the Ferris State University, College of Optometry. All subject were either employed by or students at the College. In order to participate in the experiment, each subject was required to have been a prior rigid gas permeable (RGP) lens wearer. Each of the three patients had no evidence of anterior segment disease.

LENSES: The two lenses studied were of Fluoroperm 60 (Paragon Optical, Inc., Mesa, AZ.) and Boston RXD (Polymer Technology Corporation, Wilmington, MA.) material. Three diameters (9.6mm, 9.2mm, 8.8mm) were used with both materials. All lenses were ordered to match specifics of the patients current RGP lenses, including base curve, power, overall diameter, secondary and peripheral curves). All lenses were verified and found to be within tolerance for center thickness, with the exception of one lens (9.2 diameter, 0.12mm thickness, Boston RXD).

In order to maintain consistency, the Fluoroperm 60 lens was placed on the right eye for each of the three subjects. All three lenses were designed on a bicurve system, with measurements coinciding with the patients' current lens specifications. Each lens was soaked in Barnes-Hind Soaking Solution for a minimum of 24 hours prior to measuring position and movement.

VIDEO SYSTEM:

CALIBRATION: Calibration was obtained by placement of a millimeter rule at the position of the patient before the camera. Markings were made at one millimeter intervals on a clear sheet of acetate as projected on the video monitor. The calibrated measuring rule was used to take measurements of both vertical post blink movement and vertical positioning from recorded images on the video monitor.

MEASURING MOVEMENT: Both lenses of equal thickness were inserted into the subject's eyes beginning with 0.09mm center thickness and continuing in increasing order through 0.21mm thickness. The lenses were allowed to settle for a minimum of one minute before taping. Each patient was instructed to blink normally during the recording period. In order to maintain consistency, the right eye was always taped first for each of the five center thicknesses. Between the three subjects, the number of blinks during the recording period for each eye ranged from seven to twenty nine, depending upon the patient's blink frequency as well as duration of recording period. Vertical post blink lens movement measurements were obtained immediately following each blink. Measurements were obtained by averaging the extent of vertical movement of each lens with reference to its inferior edge.

RESULTS

Statistical analysis was not performed on the data to determine significant variance. Figures 1-3 show the average vertical post-blink movement for both lenses. A composite average for all three subjects is demonstrated in Figure 4. Figures 5-7 show the average vertical post-blink lens position relative to the lower lid. A composite average for all three subjects is shown in Figure 8. Observation of the data appears to indicate no significant difference in fit between the Fluoroperm 60 and Boston RXD lenses. Analysis of both composite graphs appears to indicate the fit for the Boston RXD lens to be slightly more stable throughout all five thickness changes for both vertical post-blink movement and positioning.

As expected, the lens with the higher specific gravity (RXD) weighed more for each center thickness than did the lens material of lower specific gravity (Fluoroperm 60). All lenses were weighed using an analytic scale at Paragon Optical, Inc., Mesa, AZ.

DISCUSSION

A proper rigid gas permeable contact lens fit is largely dependent upon both center thickness and specific gravity. Alterations of these variable can affect both vertical lens positioning and post-blink movement. An increase in center thickness results in a shift of the center of gravity toward the front surface of the lens. This shift not only contributes to both lower vertical position of the lens, but a decrease in the adherence of the lens to the cornea as well. An increase or decrease in specific gravity has been suggested by Quinn and Comstock to potentially be a vital tool for the clinician in providing adequate lens performance to their contact lenswearing patients.

Graphical analysis appeared to indicate no significant difference in post-blink vertical movement for all three subjects for all thicknesses except for the 0.21mm thickness for Subject 3 and the 0.18mm and 0.21mm thicknesses for Subject 1. For all three subjects, the Boston RXD lens appeared to retain a more stable fit over all five thickness changes. An average of vertical post-blink movement for all three subjects revealed no significant difference between the two lenses.

Vertical lens position varied considerably between all three subjects. Vertical post-blink positioning was measured with reference to the lower lid. Previous studies have used the center of the pupil as a point of reference for evaluation of vertical positioning. Quantification of position with this method observation would provide more reliable data and is recommended for future studies.

Graphical analysis revealed a significant difference in vertical positioning between the two lenses with both the 0.18mm and 0.21mm thicknesses for Subject 1. A large difference was noted with the 0.09mm thickness for Subject 2. No real significant variation occurred between the two lenses for the remaining five thicknesses. Some tearing was noted with Subject 2 with all thicknesses except 0.09mm and 0.12mm due to lens irritation. All data collected following tearing was neglected as a result of alteration of the fit.

Subject 3 experienced no significant change in vertical lens positioning for all thicknesses. All lenses were found to rest on the lower lid. A significant inferior temporal movement was noted for both lenses with increasing thickness.

For all subjects, except Subject 3, the Boston RXD lenses appeared to retain a more stable vertical position with change in thickness than did the Fluoroperm 60 lens. Graphical analysis of the composite data shows no real significant difference between these two lenses.

Due to the identical fitting variables (base curve, power, etc.) between the two lenses in Subject 1, the two lenses were switched between the eye in order to investigate any similarities or differences in fit as compared to the initial lens. Both lenses fit nearly identical to the initial lens, indicating a possible anatomical corneal difference between the two eyes having an impact on comparison of fit between the two lenses. A previous study compared the Boston Equalens to the Fluoroperm 60. Data was collected using only one of the two eyes. Maintaining identical parameters between the two lenses, with exception to the variable under study, on the same eye may be necessary in comparing the differences and similarities in fit between the Fluoroperm 60 and RXD.

REFERENCES

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4. Quinn, T.G., Comstock, T.L., The Influence of Specific Gravity on Vertical Positioning of RGP Lenses. ICLC 16 (11,12): 346, 1989.

5. Quinn, T.G., Comstock, T.L., The Influence of Specific Gravity on Vertical Positioning of RGP Lenses. ICLC 16 (11,12): 342, 1989.

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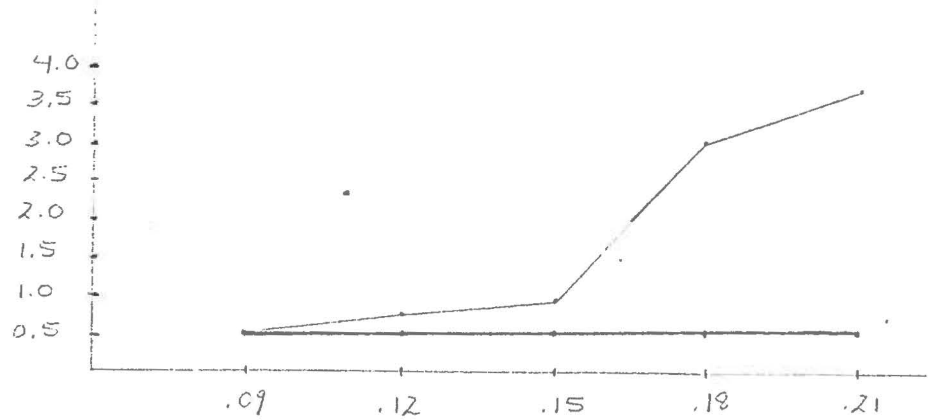
Data
Vertical.
Post - Blink
Movement
(mm)

9.6mm Diameter = Subject #1

— O.S. Boston [illegible]

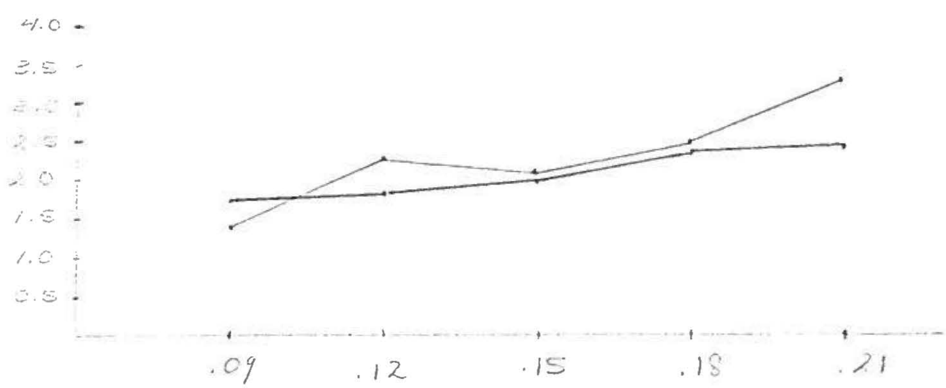
Figure 1



Thickness in (mm)

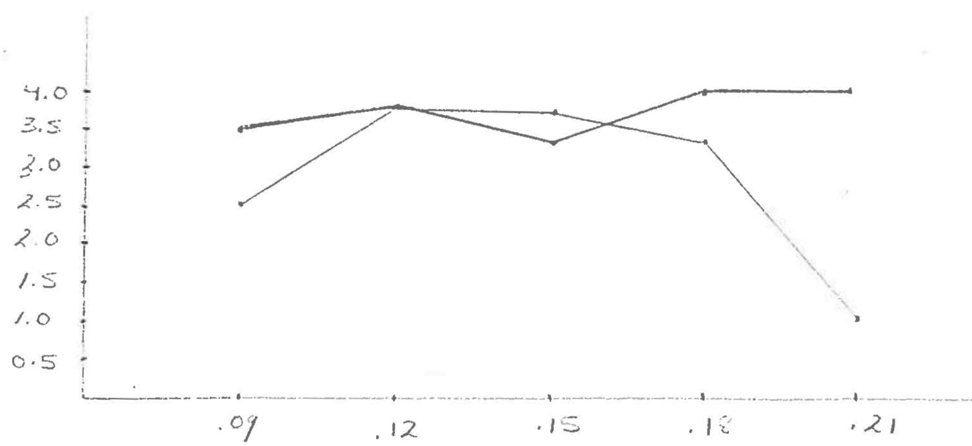
9.2mm Diameter = Subject #2

Figure 2



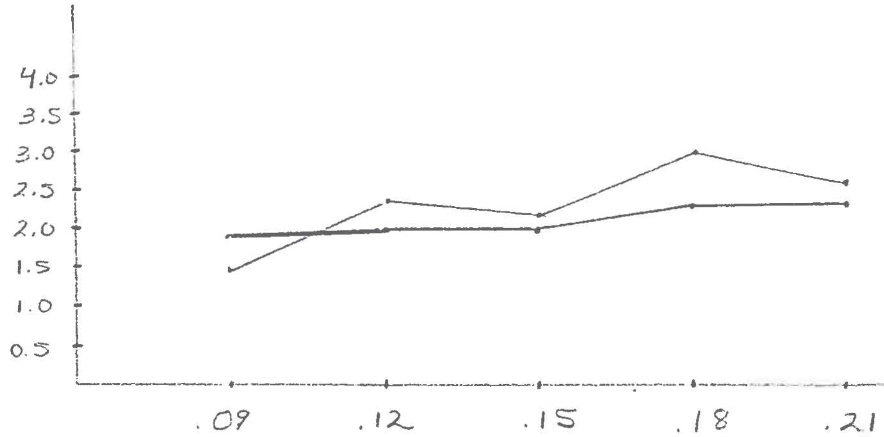
2.8mm Diameter = Subject #3

Figure 3



Composite : Fluoroperm 60 vs. Boston RXD

Figure 4



Data
Lens Position (Vertical) in mm

- O.D. Fluoroperm 60
- O.S. Boston RXD

9.6 Diameter = Subject #1

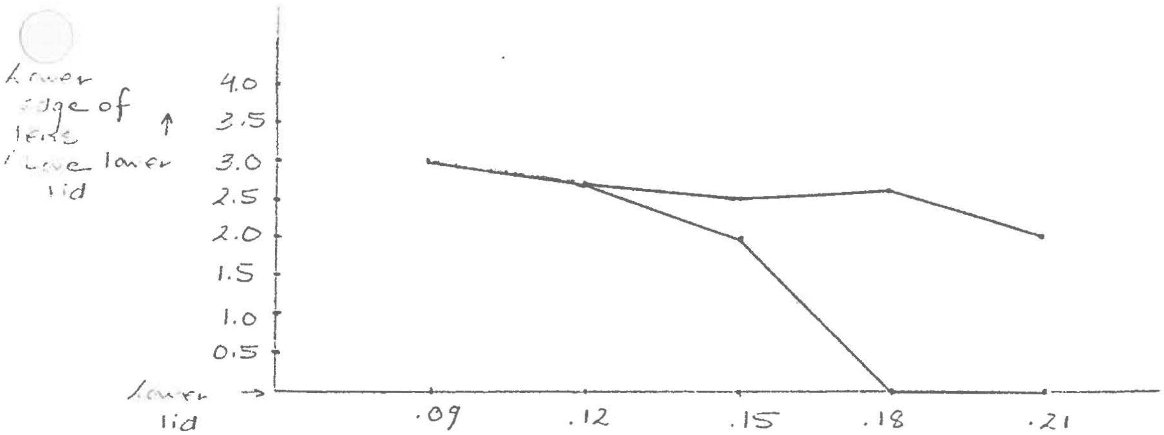


Figure 5

9.2 Diameter = Subject #2

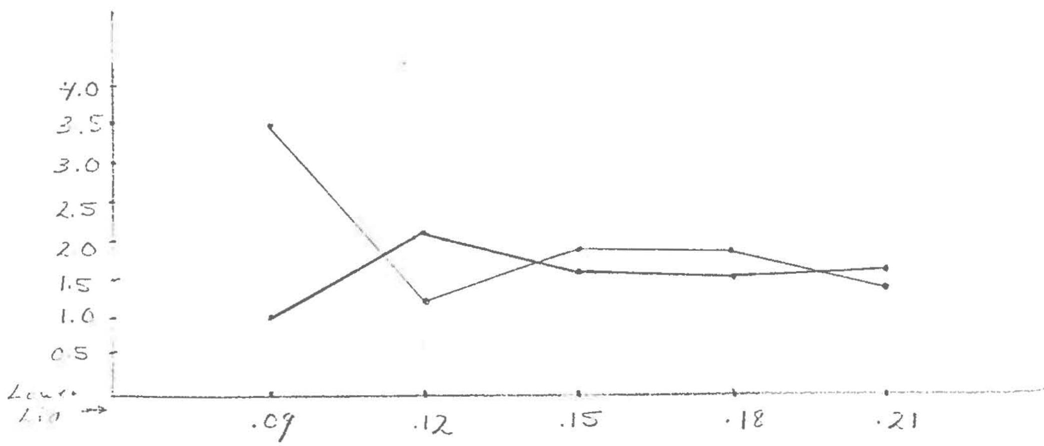


Figure 6

8.8 Diameter = Subject #3

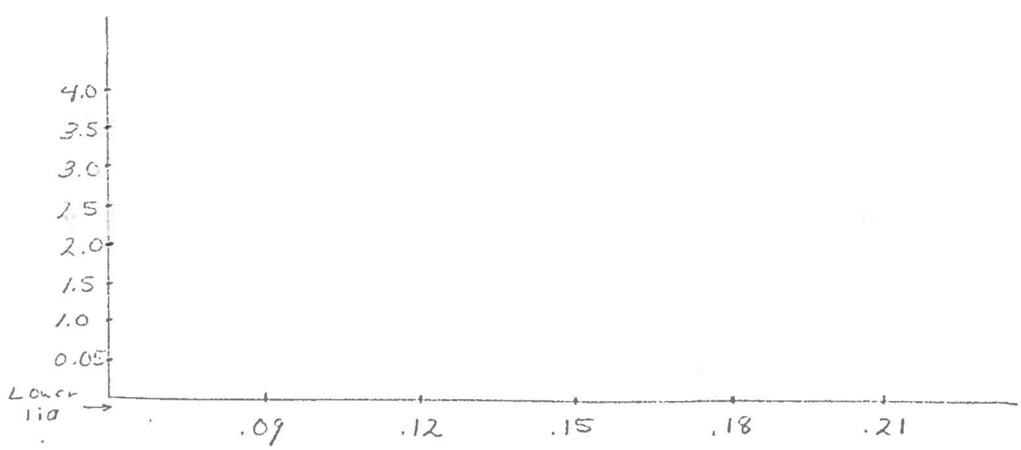


Figure 7

Lens remained on lower lid both right & left eyes, all thicknesses

Composite Fluoroperm 60 vs Boston RXD

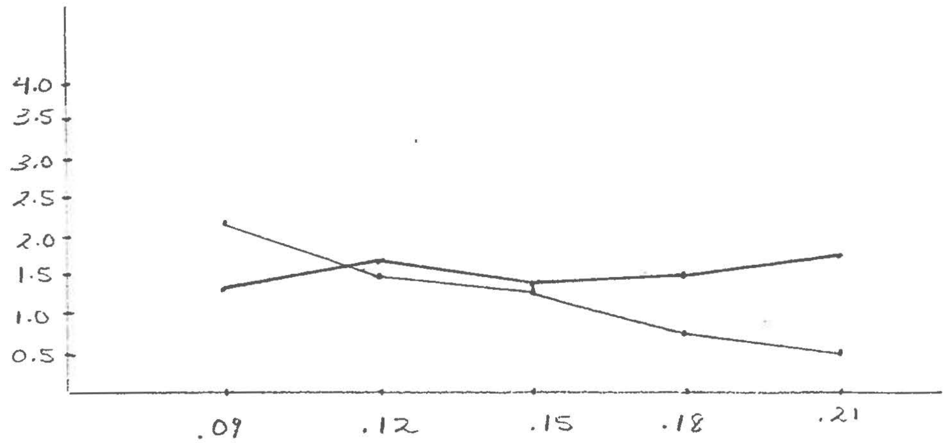


Figure 5