USING COMPUTER BASED TOPOGRAPHY PROGRAMS FOR INITIAL FIT OF RGP LENSES

by

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ABSTRACT

Background: Computerized corneal topography manufacturers argue that videokeratoscopy instruments can hypothesize a more accurate initial contact lens fit in comparison to empirical fits because the instrument gives more information about the surface of the cornea. Three rigid gas permeable contact lens' fitting software programs were analyzed in an effort to determine how the initial fit of the lenses designed by the programs compared to those of an empirical lens fit. *Methods:* A total of 40 eyes were included in the study. Topographies were obtained on both the Humphrey and Medmont topographer, and the Humphrey Masterfit software, Medmont Studio software, and Focal Points software were used to analyze the topographies. Four different contact lenses were order for each eye based on the three topographies and empirical data. The lenses' initial fits were then compared based on vertical centration, horizontal centration, base curve, edge lift, and over-refraction. *Results:* Of all initial fits, 25.0% were optimal in all categories analyzed. Refraction showed the most variance between the groups with the Medmont studio and the Humphrey Masterfit proving to be optimal more often than the empirical fit within this category. *Conclusions:* Based on the results of this study, computerized corneal topographic software programs have shown to have comparable results to empirical fitting method as a starting point for rigid gas permeable fitting.

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Introduction

Ever since the computerized corneal topographer was introduced, companies have been working hard to develop a rigid gas permeable (RGP) lens fitting program. These programs have the potential to serve multiple roles including providing detailed contact lens parameters with precision that is similar to the classic empirical method of contact lens fitting. Computerized contact lens fitting software may also decrease in-office chair time by limiting the number of RGP refits per patient[1].

Rigid gas permeable lenses have several advantages, including their increased safety over hydrogel lenses, their deposit resistance, and their ability to fit a wide variety of corneal surfaces and refractive types[2]. Even with these advantages, a 2006 review found that the percentage of contact lens wearers that are fit with RGP's has remained static at 10-14% over the past decade[3]. Most sources attribute this small percentage to two major dilemmas associated with RGP's. The first is discomfort for the patient. The second disadvantage is the need for numerous trials with different lenses to attain the ideal lens fitting[2, 4].

Computerized corneal topography manufacturers argue that videokeratoscopy instruments can hypothesize a more accurate initial contact lens fit in comparison to empirical fits because the instrument gives more information about the surface of the cornea[5]. The classically used empirical method of RGP fitting uses keratometry readings to select the base curve of the lens. These keratometers take the numeric average of four points near the center of the cornea and omit information about the peripheral cornea completely[6]. This can lead to inappropriate lens designs. Computerized corneal topographers generate thousands of data points of the central and peripheral cornea and deliver a detailed map of the contour[5]. These measurements allow a better estimation of the base curve-to-cornea fitting relationship[4].

Purpose

To analyze three, topography based, rigid gas permeable lens fitting software programs by comparing the initial fit of the derived lenses, based on appearance and refractive error, to that of traditional empirical fitting.

Methods

A total of 40 eyes, with less than 2.00 D of astigmatism and free from pathological eye conditions were included in the study. Keratometry readings ranged from 41.00 to 48.25, and spectacle spherical equivalent powers ranged from -9.75 to +1.75. The study was performed in Big Rapids Michigan at the Michigan College of Optometry, and all subjects were students between the ages of 20 and 30 that attended the Michigan College of Optometry.

At the initial appointment, visual acuities, retinoscopy, subjective refraction, and keratometry were performed on each patient. In addition, two corneal topographies were taken using the Medmont E300 topographer and the Humphrey Atlas topographer. This initial information was used to order the rigid gas permeable lenses.

Four spherical contact lens designs were selected for each eye. Generally, 2.50 D of astigmatism or more are required for a toric gas permeable lens to be necessary[2]. Criteria for the study excluded subjects with over 2.00 D of corneal astigmatism in an attempt to make it possible for spherical fits to be the best choice for all patients. 27.5% of the 40 eyes studied had astigmatism between 0.50 D and 1.75 D.

The first lens design was selected using a traditional empirical method. All base curves were selected "on K". Diameter was set at 9.0, with a 7.0 optic zone. Boston ES contact lenses were designed by Art Optical. The manufacturer selected the peripheral curves for each lens.

The second lens was designed using the Humphrey MasterVue Software including the MasterFit contact lens fitting module. This program uses an arc-stepped algorithm for calculating the corneal elevation data[7]. The program gives the option of using keratometry readings or topography results to design the contact lens. This study evaluated the contact lens fit using topography data only. Base curve and power were selected by the MasterFit program. Diameter was, again, set at 9.0 with a 7.0 optic zone, and peripheral curves were set by the software. Art Optical supplied the Boston ES contact lenses.

The Medmont topographer comes with its own contact lens fitting package, Medmont Studio, fully integrated into the software. Manual adjustments and repositioning of the lens are possible but were not performed for this study[8]. Refractive error was entered into the program and base curve, peripheral curves, and power were given. Diameter was set at 9.0 with a 7.0 optic zone and all lenses used were Boston ES supplied by Art optical.

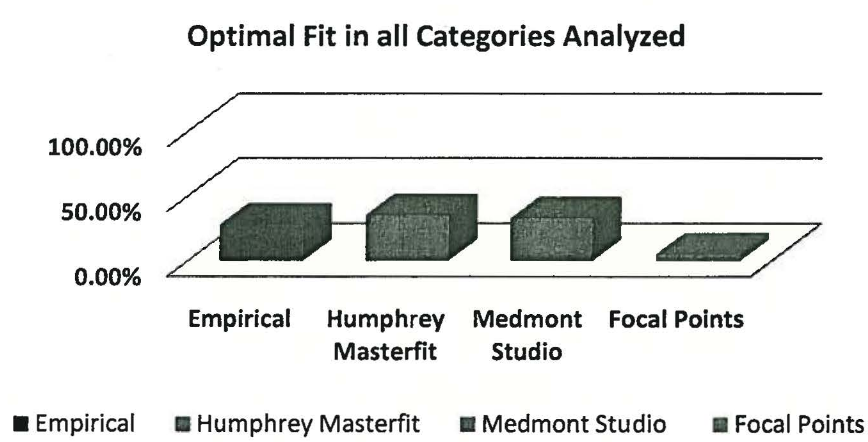
The final contact lens design used was based on the Focal Points program, also designed to be used with the Medmont topographer. Focal Points differs from most topography fitting software in that the actual topography and refractive error is sent to the manufacturer and the correct lens is selected there. The focal points program chooses diameter, optic zone, peripheral curves, and power.

The lens fits were examined by two masked third year optometric students at the Michigan College of Optometry. The four different lenses were placed on the eye in a randomized order. Subjective over-refractions and flourescein staining evaluations complete with slit lamp photography were then performed. Photography was taken right after the blink in all occasions in order to more accurately analyze centration. Anesthetic was used in the fitting procedure. Therefore, subjective information about the comfort of the fit was not recorded.

Quality of initial fit was analyzed by one masked investigator who scored vertical centration, horizontal centration, base curve, edge lift, and over-refraction. The lenses were scored in the above categories and ranked as optimal or non-optimal. Centration was considered optimal in all cases where the central 6.0 mm of the cornea were covered in the post-blink slit lamp photo. Base curve was deemed optimal when the lens showed sufficient apical clearance over the central 6.0 mm with midperipheral touch and absence of apical bubbles. Edge lift was ranked as optimal if there was a clearance of 0.5 mm-1.0 mm. The over-refraction was optimal if it fell in the range of +0.50D to -0.50D with no more that 0.5 D of astigmatism.

Results

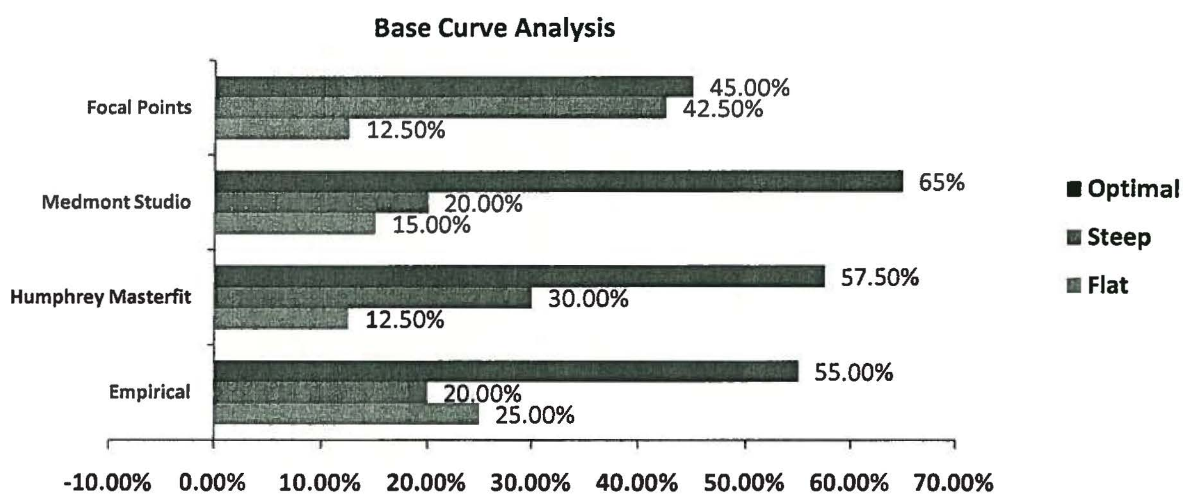
Of all initial fits, 25.0% were optimal in all categories, including vertical and horizontal centration, base curve, edge lift, and over-refraction. 27.5 % of empirical fits, 32.5% of Medmont Studio fits, 35.0% of Humphrey MasterFit fits, and 5.0% of Focal points fits were optimal.



Overall, vertical centration appeared to be optimal in most conditions, with only 11% decentered. When comparing the lenses based on contact lens fitting software to the empirical fit there was no statistically significant difference between the groups in regards to vertical centration (p=10.767).

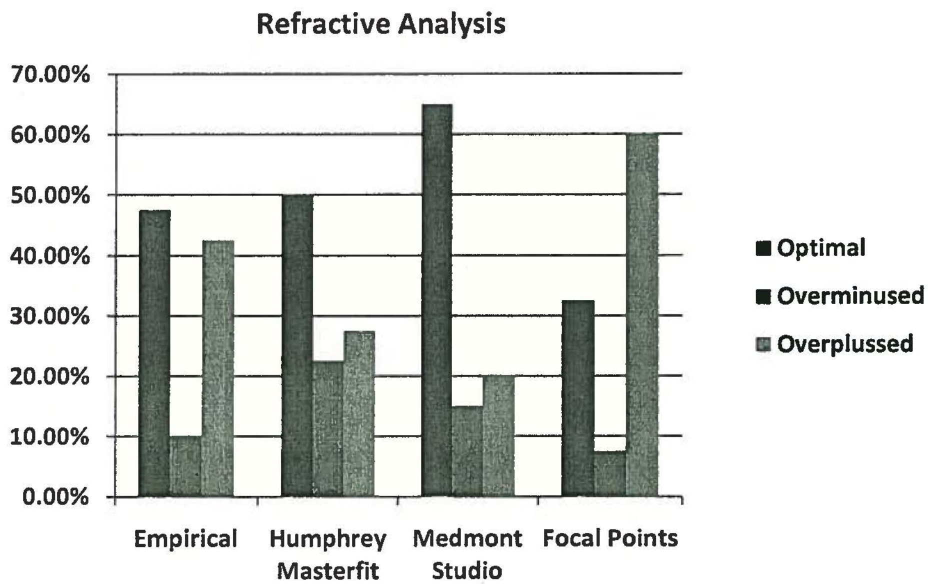
Horizontal centration was also optimal in most cases. 6.2% of the lenses were decentered. Statistically, there was not a significant difference when comparing the lenses based on contact lens fitting software to those fit empirically (p= 4.693).

Base curve analysis revealed that the empirical fit was optimal in 55% of eyes analyzed. The Medmont Studio program proved to have an optimal curvature the most often (65%). This difference was not statistically significant when compared to the empirical fit (p=0.247). The MasterFit's fit was optimal in 57.5% (p=0.500) of eyes, and Focal Points was optimal 45.0% (p=0.186) of the time.



Edge lift was optimal in most conditions, including 90.0% of all empirical fits. Medmont Studio, MasterFit, and Focal Points were fit optimally in 77.5% (p=0.247) , 82.5% (p=0.259), and 75.0% (p=0.186) of eyes respectively.

Out of all of the categories analyzed, refraction revealed the most variance between the groups. The empirical lenses refraction was considered optimal in 47.5% of eyes analyzed. The Medmont Studio fit was optimal in 65.0% (p=0.088) of eyes, the MasterFit fit in 50% (p=0.500) of eyes, and the focal points fit in 32.5% (p=0.127) of eyes.



Discussion

To classify the fit, we chose to use five commonly analyzed parameters and assess them using flourescein pattern and over-refraction. We realize that the manual and subjective grading has some limitations but at this point, no reliable objective technique for measuring the fit is available.

It should be noted that all of the topography software mentioned in this study comes with the ability to show the analyzer a simulation of what the flourescein pattern should look like on the eye. If the fit looks unsatisfactory in the simulation, parameters can be manipulated and a new flourescein pattern will be displayed. The feature is meant to decrease the number of trials needed before a correct fit is found for the patient by allowing the practitioner a preview. This feature was not used in the study. Had it been used, the number of successful fits would have, more than likely, been a higher proportion of eyes fit.

A 2002 article in Contact Lens and Anterior Eye found that the initial contact lens used for an RGP empirical fit is satisfactory in approximately 40% of fittings and cited a previous study that found the initial fit to be acceptable in 85% of all trials[2]. The data found in this study finds the number of satisfactory fits using empirical fitting methods to be only 27.5%. This suggests that the criteria applied to evaluate the lenses in this study was more critical than that of the aforementioned but if the empirical fits should, in fact, be more successful under most conditions, then the relatively low percentage found in this study could skew the data in favor of the topographical software.

Conclusion

Based on the results of this study, computerized corneal topographic software programs have shown to have comparable results to empirical fitting method as a starting point for rigid gas permeable fitting. If the information in this study proves to be repeatable, computerized corneal topographers have yet another niche in contact lens practice.

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