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Comparison of automated versus traditional methods of RGP lens verification

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Abstract

BACKGROUND The purpose of this study is two-fold. First, it will be demonstrated that there is no mean offset between base curve verification measurements obtained using a hand-held autokeratometer as opposed to the traditional verification method using a radiuscope. Secondly, the clinical perspective will be explored by presenting the likelihood of any significant difference which may be expected by a practitioner when measuring RGP base curves by automated means.

METHODS Ninety-six RGP lens base curves were measured by two clinicians five times each by traditional radiuscope method and by use of an autokeratometer.

RESULTS A statistical significant difference between the mean values of the traditional and automated methods of 0.007 mm existed. Clinically, this value is insignificant due to the +1- 0.02 mm error allowed by the ANSI standard for rigid gas permeable lenses.

CONCLUSIONS Automated RGP base curve parameter verification using an Alcon Renaissance autokeratometer was found to be as clinically accurate as that done with the use of a radiuscope. Autokeratometer base curve verification also proved to be time efficient and cost effective.

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Comparison of Automated Versus Traditional Methods of RGP Lens Verification

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BIOGRAPHY

Rob Christensen is a 1993 graduate of Boise State University with a B.S. degree in Health Science. He is currently working toward his Doctor of Optometry degree at Pacific University with planned graduation in May, 1997. Rob is a member of BSK as well as OEP. His future plans include practicing in a multi-disciplinary private practice in the great northwest. He has special interests in contact lenses and pediatric optometry.

Tara Quinn has an A.S. degree in Biology from Yuba Community College and a B.S. degree in Visual Science from Pacific University. She is currently working toward her Doctor of Optometry degree at Pacific University College of Optometry with planned graduation in May, 1997. At Pacific, Tara served as faculty representative in the SOA in 1995-96. She is also a member of BSK, OEP, and AOA-PAC. Tara is currently investigating a career in optometry with either the Indian Health Service or the military. Her future plans also include a possible residency.

ABSTRACT

BACKGROUND The purpose of this study is two-fold. First, it will be demonstrated that there is no mean offset between base curve verification measurements obtained using a hand-held autokeratometer as opposed to the traditional verification method using a radiuscope. Secondly, the clinical perspective will be explored by presenting the likelihood of any significant difference which may be expected by a practitioner when measuring RGP base curves by automated means.

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KEY WORDS

autokeratometer, rigid gas permeable lens (RGP), radiuscope, base curve, parameters, verification

INTRODUCTION

It's a busy afternoon and you need to verify the parameters of a new patient's rigid gas permeable lenses. Two patient's walk in asking to pick-up their new spectacles and one elderly gentleman needs his glasses adjusted. The phone rings with a call from a long-time patient who needs a new contact lens to replace the one she just lost. Time is precious and managing the bulky radiuscope to measure the base curves of the RGP patient's lenses is a nuisance. Thankfully you know of an accurate alternative method of measuring RGP parameters which is not only much faster but quite a bit simpler. In your practice you have a hand-held autokeratometer which you have found to be useful as a method of measuring RGP base curves. All you need to do is place the RGP to be verified on a drop of solution on a countertop and, using an autokeratometer, with the press of a button, the lens' base curve is measured. If only the other office crises could be managed so quickly and accurately.

Use of automated RGP lens verification can be of great benefit in many areas of the optometric practice. Most importantly, it requires little training of office staff, less procedural confusion, and accuracy comparable to verification methods used in the past. RGP lenses sent from the lab can be quickly verified for accuracy and, if need be, modified or returned to the lab when parameters are incorrect.

Financially, using automated instruments in the verification of RGP lenses is very cost effective. Both keratometric as well as base curve identification provided by an autokeratometer can be easily performed and inputted into computer patient files. Not to mention how impressed patients are to see their optometrist using modern, "cutting edge" automated equipment.

Verification of RGP lens parameters is an important part of any contact lens practice, with the impact of incorrect lens base curves worn by a patient being of great concern. A good RGP lens fit is achieved only by the use of correct parameters allowing for clear vision, good movement and sufficient lens clearance. Poor lens fit due to inaccurate parameters leads to a very disagreeable patient with red, swollen eyes. Accurate verification of RGP base curve before the patient ever places the lenses in his/her eyes can make a tremendous difference in lens acceptance.

The purpose of this study is two-fold. First, it will be demonstrated that there is no mean offset between base curve verification measurements obtained using a hand-held autokeratometer as opposed to the traditional verification method using a radiuscope. Secondly, the clinical perspective will be explored by presenting the likelihood of any significant difference which may be expected by a practitioner when measuring RGP base curves by automated means.

METHODS

The base curves of 96 rigid gas permeable (RGP) lenses were verified separately by each of two clinicians first using the standard Rychert radiuscope and then again using the Alcon Renaissance hand-held autokeratometer. Efforts to minimize error and strengthen validity of the findings were employed by measuring each lens five times by each clinician. Mean base curve values of the lenses verified with traditional methods were then compared to those measured with the autokeratometer to check for any significant differences. The RGP lenses measured were of varying parameters (base curve, diameter, back vertex power, center thickness, etc.) with the base curve being the parameter of interest for the study.

Traditional verification with the radiuscope derives the base curve of the RGP by measuring the distance between the back lens surface and the aerial image (at the center of curvature of the lens).[1] The contact lens is "floated" concave side up on a drop of solution which is placed in the lens mount. Care is taken to remove bubbles in the solution and any dirt on the lenses which cloud the image and also make measurement difficult. In this study Allergan's Resolve GP was used as the solution to neutralize (block out) the convex front surface of the lens in order to prevent false readings.[2] The lens is then left a few moments before verification begins so that lens settling does not affect the measurement. The first star burst image encountered by the radiuscope when turning the focusing wheel away from the verifier's body (i.e.: clockwise), is the lens surface image. The measuring dial is then set at zero before focusing the scope upward, past a filament image, to the second star burst image. This second star burst image is termed the aerial image and is the image reflected from the lens surface. It is at the aerial image that the base curve is determined by noting the position of an indicator line on a millimeter scale located to the right of the image. At this point the scope is returned to the first image by turning the focusing wheel counter-clockwise to see if the instrument still reads "0" and has not shifted.[1]

To begin lens verification using the Alcon Renaissance autokeratometer, a drop of Allergan's Resolve GP solution was placed on a tabletop. An RGP lens, concave up, was then positioned on the drop of solution and the autokeratometer was brought down and held a few centimeters away from the lens surface to take the measurement.

Alcon's Renaissance autokeratometer uses four "projectors" positioned behind a window around the central aperture of the instrument.[3] As the alignment button on the instrument is depressed, these projectors shine a pattern of eight green lights on to the contact lens. These lights are used to monitor proper positioning and alignment of the instrument when readings are taken. When the green lights are focused and form an "X" pattern in the center of the contact lens, the alignment button is released, and a base curve measurement is automatically taken and displayed in the main window of the instrument.[3] Care should be taken to make sure that the operator's head and the autokeratometer are both aligned perpendicularly to the contact lens for measurements to be accurate.[4] The base curve is given in diopters and millimeters for each reading made when the instrument is switched into "base curve setting" prior to taking measurements.

RESULTS

Mean offset between base curve verification measurements obtained using a hand-held autokeratometer as opposed to the traditional radiuscope verification method (using a two tailed hypothesis repeated measured t-test with $p < 0.05$) resulted in a statistically significant difference of 0.007 mm. According to the

American National Standards Institute (ANSI) the allowable error made in measuring RGP base curves is +/- 0.02 mm,[5] therefore making the magnitude of the statistical difference of this study too small to be clinically meaningful. (Refer to Figure 1 for a scattergram which demonstrates the correlation between the readings of the autokeratometer and the traditional radiuscope.)

Insert Figure 1 About Here

An expected frequency for a clinician obtaining a base curve reading using the hand-held automated keratometer which is outside of the ANSI limits would be approximately 0.1875% of the time. (Refer to Figure 2 for a detailed frequency histogram of mean value differences.) It is believed that with an increased familiarization of use that the frequency of base curve measurements made outside of ANSI standards would decrease.

Insert Figure 2 About Here

During the process of collecting data with the hand-held autokeratometer it was noticed that direct sunlight interfered with (washed out) the instruments projectors. These projectors are used by the instrument in determination of the base curve of the desired object. To prevent this problem, always make measurements in an area that does not have greater peripheral light (i.e., sunlight shining through a nearby window) than central working light. Overhead fluorescent or tungsten incandescent lighting created no disturbance in the instrument's calculation of base curves.

Also noted while collecting data was the importance of centering the eight green alignment lights in the concave surface of the RGP lens. If the green alignment lights are off center, a measurement of induced cylinder will be made by the autokeratometer.

DISCUSSION

Alcon's Renaissance autokeratometer provides many benefits to an optometric practice. One of the most obvious benefits lies in having a single instrument that provides a service normally supplied by two separate instruments. As demonstrated in the preceding results presented for this experiment, Alcon's autokeratometer provides clinically accurate measurements of rigid gas permeable lens base curves in addition to its intended purpose of taking keratometric readings. When it comes down to the bottom line of expense, practitioners want an instrument with versatility that is fast and easy to use and that office staff members can quickly be trained on, thereby freeing up valuable time for the practitioner.

Ease of use is the characteristic which best describes Alcon's Renaissance autokeratometer. When compared to the procedures necessary in using a traditional radiuscope to measure RGP base curves, the autokeratometer is much more versatile and creates less mess and frustration. Radiuscopes are relatively large, gangly instruments which require sufficient tabletop space for storage. Positioning of the lens so that it floats on "bubble-free" liquid can be frustrating, not to mention the need for good accommodative skills in order to focus the instrument's "star burst" mires accurately when making a base curve reading. If just one or two base curve readings need to be made and there is no rush, these frustrations can be dealt with, but most offices providing contact lens services generally do not have the available free time to deal with these nuisances.

In contrast, the autokeratometer is portable and stored in its own charger unit, allowing it to always be ready for the next keratometric or RGP base curve verification. All that is needed to make a base curve reading is a flat surface and a single drop of a semi-viscous solution. Accommodative sustaining ability is not needed to the extent of that required when using a radiuscope. Just align the mires, depress a large button and the instrument does the rest. Little training of office staff members is required for accurate measurements to be made. Radiuscope training, on the other hand, requires many more steps as outlined in the Methods section.

While the time taken to verify contact lenses with traditional methods versus automated methods was never clocked with a stopwatch by the clinicians in this experiment, it should be noted that traditional verification required approximately twice the amount of time than did the automated method of verification. For an optometric practice, this means that less time can be spent verifying RGP base curve parameters and more time spent attending to the other needs of a busy office.

Another unique and useful feature of the Renaissance autokeratometer is that it can either produce a hard copy (printout) of the patient's keratometric readings and RGP base curve parameters or the data can be directly downloaded into the patients files in the Alcon IVY computer software system. As stated in Eyecare Technology , "Instrument-to instrument hookups speed information flow through the office or lab, in turn improving patient flow. In this way users can keep up with the increased flow of patients or prescriptions without sacrificing quality of care...By incorporating dumping of data into practice management systems, manufacturers are preparing users for managed care in a big way. Data that doesn't have to be transcribed and re-entered is undoubtedly more accurate, nearly eliminating time wasted on fixing mistakes."[6]

Naturally, when considering the addition of a new piece of optometric equipment to a practice, the time and money saved with the instrument must justify the expense. Table 1 lists the costs, uses, and advantages of the Alcon autokeratometer and the traditional radiuscope.

Insert Table 1 About Here

Unfortunately, 1996 is the last year that the Alcon Renaissance autokeratometer will be produced. For this reason, a practitioner would be well advised to seriously consider purchasing such a useful piece of equipment in the near future and therefore help to make those hectic days, when patient demands seem to be coming faster than can be handled, run a bit smoother.

ACKNOWLEDGEMENTS

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Table 1. Comparison of Autokeratometer to radiuscope

AUTOKERATOMETER	RADIUSCOPE
USES: -keratometry -base curve measurement -assessment of gross corneal topography -reading print out -input to the Alcon IVY system -versatility for elderly, infants, handicapped	USES: -base curve measurement
ADVANTAGES: -two instruments in one -easier and quicker -portable -less lens manipulation and fumbling -readings not as affected by user over-accommodation	ADVANTAGES: -less expensive
COST (1996): -about $4,000.00	COST (1996): -monocular: $1,195.00 -binocular: $1,595.00

Figure captions

Fig. 1. Scattergram of relationship between base curve measurements made with radiuscope and autokeratometer.

Fig. 2. Frequency histogram of differences between base curves as measured with radiuscope and autokeratometer.

Figure 1

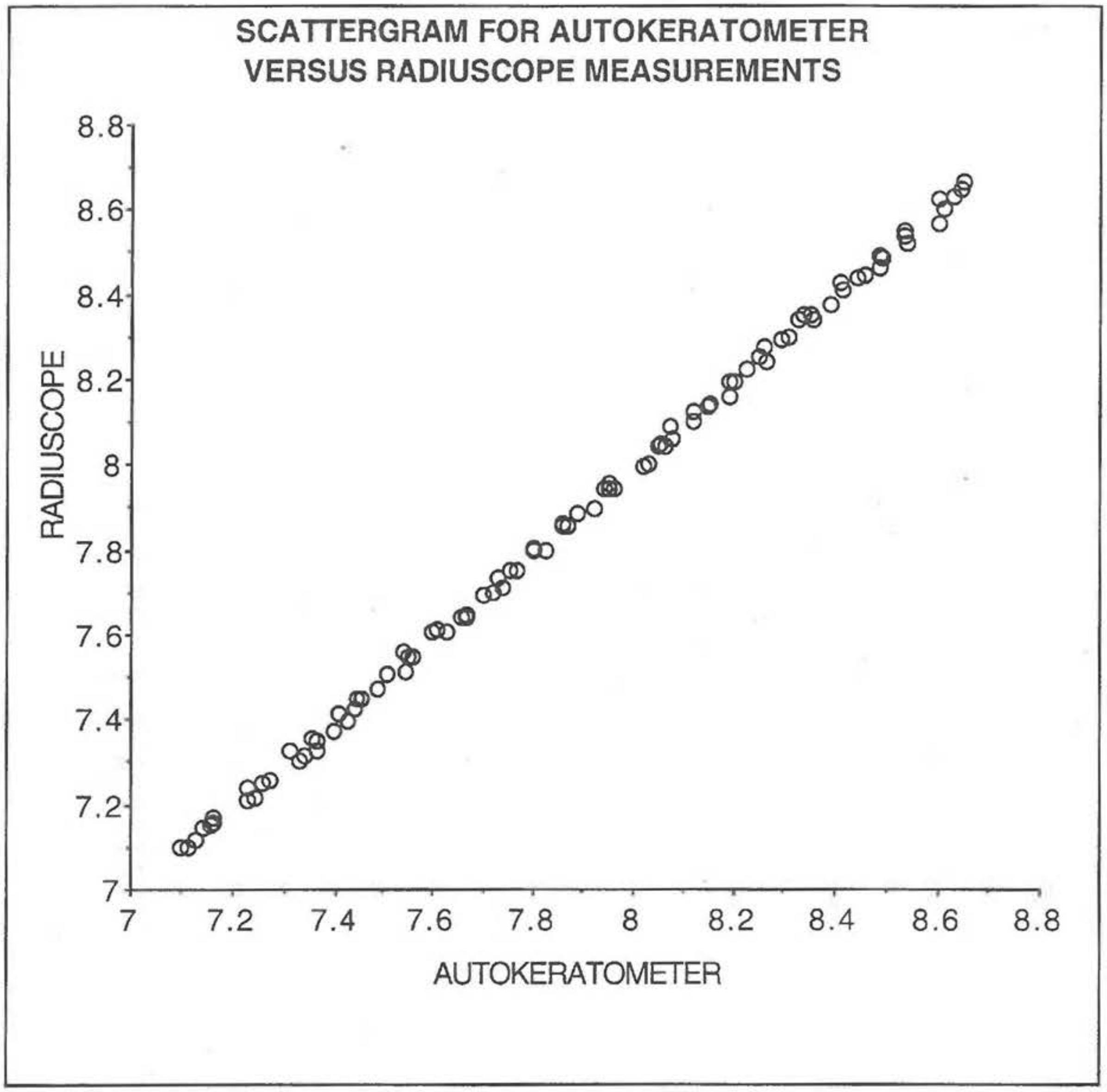
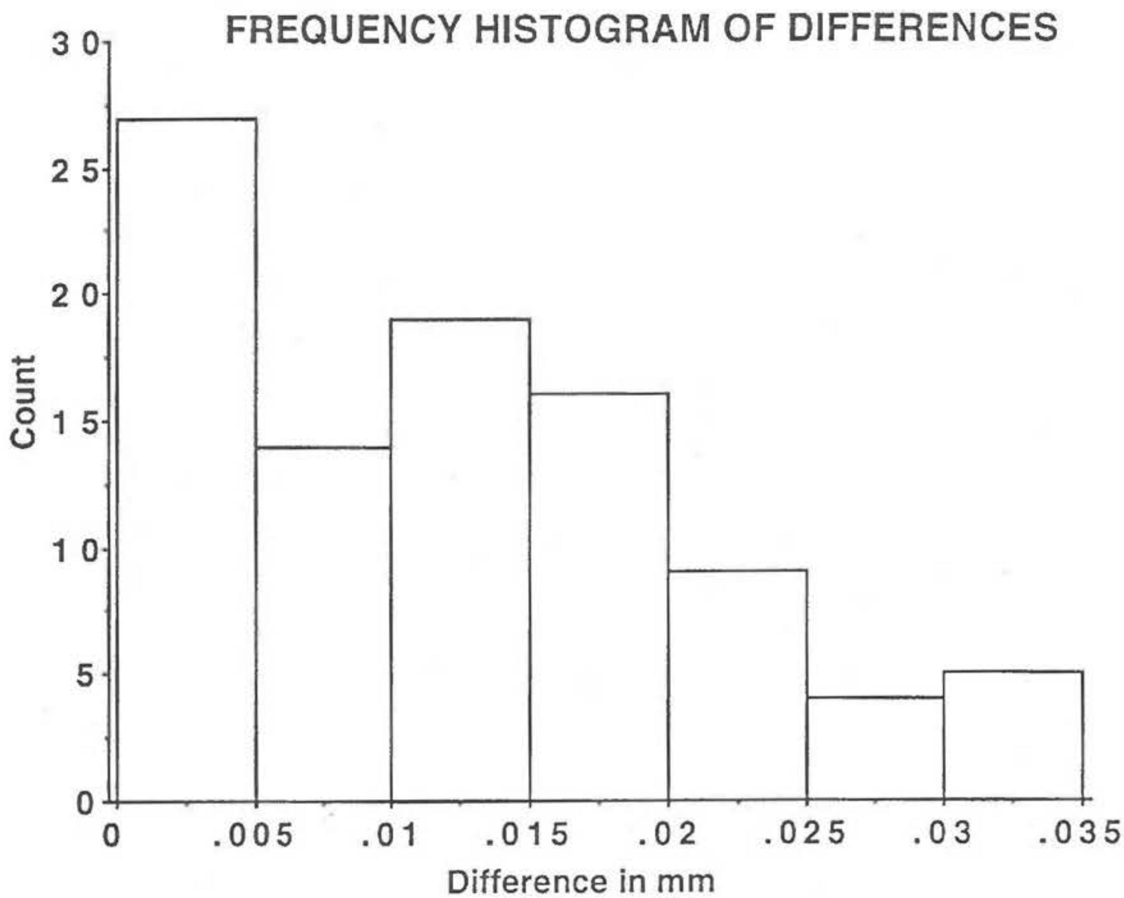

SCATTERGRAM FOR AUTOKERATOMETER
VERSUS RADIUSCOPE MEASUREMENTS
RADIUSCOPE
8.8
8.6
8.4
8.2
8
7.8
7.6
7.4
7.2
7
7
7.2
7.4
7.6
7.8
8
8.2
8.4
8.6
8.8
AUTOKERATOMETER

Figure 2



FREQUENCY HISTOGRAM OF DIFFERENCES
Count
30
25
20
15
10
5
0
0
.005
.01
.015
.02
.025
.03
.035
Difference in mm