THE EFFECT OF MODERATE POWERED SOFT CONTACT LENSES ON REBOUND TONOMETRY

by

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Has been approved

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APPROVED:

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ABSTRACT

Background: Rebound tonometry is a method of measuring intra-ocular pressure (IOP) that does not require the use of corneal anesthesia. In the clinical setting, rebound tonometry is often used as a screening of IOP in pediatric patients and for those who are apprehensive of applanation tonometry. IOP screenings are often done as part of a pre-testing regimen, during which a patient may be wearing contact lenses. The purpose of this study is to determine if rebound tonometry performed with ICare® provides an accurate measure of IOP through moderate powered soft contact lenses. *Methods:* In a sample size of 32 subjects, baseline intraocular pressures were taken in both eyes without any contact lenses. IOPs were then taken with a +5.00 diopter (D) soft contact lenses in the right eye, followed by a -5.00 D soft contact lens in the left eye. *Results:* Intraocular pressures measured through a -5.00 D soft contact lens were found to be accurate compared to baseline readings, with a mean difference of 0.6875$\pm$0.4270 mmHg. Increased intraocular pressure measurements through a +5.00 D contact lens compared to baseline were found to be statistically significant, with a mean difference of 4.0000$\pm$0.4579 mmHg. *Conclusions:* While the measurement of intraocular pressure over a moderate powered minus lens is not significantly different than baseline, the practitioner should be aware that the rebound tonometer will increase its overestimation on intraocular pressure as the center thickness of the soft contact lens increases.

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Introduction

The measuring of intraocular pressure is a crucial part of a thorough eye examination. While intraocular pressure (IOP) is followed most closely in glaucoma patients and glaucoma suspects, it is typically screened on all patients that present for eye examinations. Goldmann applanation tonometry is considered the standard for the measurement of intraocular pressure in optometry and ophthalmology; however, various other forms of tonometry measurements are used in the monitoring of intraocular pressure in patients who are not suspect of glaucoma[1].

One alternative to Goldmann applanation tonometry is rebound tonometry. Rebound tonometry is a form of dynamic tonometry in which intraocular pressure is measured indirectly by measuring the deceleration of a magnetized probe when it bounces off the cornea[2]. Rebound tonometry may provide a faster, less invasive way to screen intraocular pressure. It is often particularly useful in children and patients who are apprehensive about applanation tonometry.

Comparisons between rebound tonometry and other forms of tonometry have been mixed. In a study comparing results of rebound tonometry versus Goldmann applanation tonometry, it was revealed that the accuracy of rebound tonometry was comparable to Goldmann applanation tonometry in participants with low to normal intraocular pressures. However, at high intraocular pressures, rebound tonometry was shown to

overestimate intraocular pressures[3]. In a separate study comparing rebound tonometry to other forms of portable tonometry, rebound tonometry was shown to be similarly

accurate but would slightly overestimate intraocular pressure[4].

A niche that rebound tonometry has filled in some settings is to quickly screen intraocular pressure over soft contact lenses. Recent studies have shown that the accuracy of rebound tonometry over soft contact lenses is sufficient, but again, often overestimated intraocular pressure. There has also been found to be a statistically significant correlation between increased IOP measurements and increased corneal thickness[5]. While soft contact lenses remain relatively thin regardless of dioptric power of the lens, high plus and high minus lenses vary in thickness by a difference that can exceed 0.09mm. An increasing difference in center thickness of soft contact lenses may result in an increased error in the measurement of rebound tonometry over soft contact lenses. There is minimal research on this topic.

The purpose of this study is to provide eye care practitioners with further information regarding the accuracy of rebound tonometry over soft contact lenses. More specifically, it will compare soft contact lenses of moderate plus power and moderate minus power to baseline intraocular pressures to shed light on whether differing center thicknesses of the soft contact lenses significantly affects the intraocular pressure measurement.

Methods

This study was conducted at the University Eye Center at the Michigan College of Optometry in Big Rapids, Michigan. Subjects of the study primarily included optometry students, with a few members of faculty and staff also participating. All eyes included in

the study were determined to be healthy. There were 32 participants included in the study. After having been explained the methods and objectives of the study, each participant in the study signed a consent form.

Baseline IOPs were measured in the right eye and left eye in each participant with an Icare® rebound tonometer. A -5.00 diopter soft contact lens was then placed on the right eye and a +5.00 diopter lens was placed on the left eye. The lenses used in this study were ACUVUE® OASYS® Brand with HYDRACLEAR® PLUS. Lens parameters are provided in Appendix A. Rebound tonometry was then performed on each eye over the contact lens. The Icare® software program displays the average of 25 intraocular pressure measurements; that number was documented and used for all calculations.

Standard deviation of the mean with a 95% confidence interval was used to statistically analyze and compare data, with a null hypothesis stating that there was no statistically significant difference between the baseline measurement and the measurement after the soft contact lens was placed on the eye. Baseline intraocular pressure was compared to the measurement after the -5.00D contact lens was placed on the right eye. The same comparisons were made between the baseline pressure measurement of the left eye and the measurement after the +5.00D lens was placed on the left eye. P values lower than 0.05 were considered to be significant.

Results:

Overall, the -5.00D soft contact lens did slightly increase the intraocular pressure measurement compared to baseline. However, the difference in IOP with the -5.00D soft

contact lens was found to be statistically insignificant in the 32 eyes that were measured. The t-stat indicated that the results of the intraocular pressure measurement after placing the -5.00D contact lens on the right eye occurred within 1.6100 standard deviations (SD) away from the baseline, with a SD of greater than 2.0395 being significantly different. The P value equaled 0.1175, which was greater than the alpha value used for this comparison (0.05), indicating that these two sets of data were not significantly different. The mean difference between the baseline measurement and the measurement through the -5.00D contact lens was 0.6875 ± 0.4270 mmHg. With a 95% confidence interval, the mean difference of intraocular pressure measurement between baseline and over a -5.00D soft contact lens is between -0.1833 and 1.558 mmHg, with the IOP being slightly higher through the -5.00D soft contact lens.

The mean difference between the IOP measured as baseline for the left eye and with a +5.00D soft contact lens were shown to be significantly different, with the +5.00D soft contact lens increasing the obtained measurement. The t-stat showed that these sets of measurements occurred at 8.7354 SD away from each other, with greater than 2.0395 SD being significant. The P value of 7.293×10^{-10} was much lower than the alpha value used for this test (0.05), indicating that the measurements between baseline and over a +5.00D soft contact lens were significantly different. The mean difference between the two sets

of data was 4.0000±0.4579 mmHg, with the plus lens increasing the measurement obtained. With a 95% confident level, the plus lens increased the intraocular pressure measurement between 3.0661 and 4.9339 mmHg.

Discussion

This study showed that performing rebound tonometry over a soft contact lens results in artificially high IOP measurements. The thicker the center of the contact lens, the greater the resulting increase in intraocular pressure measurement. While the measurement of intraocular pressure over a moderate powered minus lens is not significantly different, the practitioner should be aware that the rebound tonometer will increase its overestimation on intraocular pressure as the center thickness of the soft contact lens increases.

Rebound tonometry should continue to be used as a screening of intraocular pressure when Goldmann applanation tonometry is unavailable, difficult, or contraindicated. The ability to use rebound tonometry over soft contact lenses adds to the convenience of this method of intraocular pressure measurements. However, due to the tendency of rebound tonometry to overestimate intraocular pressure when measured through soft contact lenses, this method of intraocular pressure screening should be reconsidered when examining a patient who is suspected of having abnormal intraocular pressure, or who is being monitored for glaucoma.

The practitioner should keep in mind the method of rebound tonometry has an overall tendency to increase the intraocular pressure when compared to Golmann applanation tonometry[3]. The added amount of overestimated intraocular pressure through a soft

contact lens may lead to a misleading measurement. Further investigation may be done in the future to compare these differences.

References

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3) Sahin A, Niyaz L, Yildirim N. Comparison of the rebound tonometer with the Goldmann applanation tonometer in glaucoma patients. Clin Experiment Ophthalmol. 2007; 35:335–339.
4) Garcia-Resua C, Gonzalez-Meijome JM, Gilino J, Yebra-Pimentel E. Accuracy of the new ICare rebound tonometer vs. other portable tonometers in healthy eyes. Optom Vis Sci. 2006; 83:102–107.
5) Anton A, Neuburger M, Bohringer D, Jordan JF. Comparative measurement of intraocular pressure by Icare tonometry and Airpuff tonometry in healthy subjects and patients wearing therapeutic soft contact lenses. Graefes Arch Clin Exp Ophthalmol. 2013. 251:1791-5.

APPENDIX A

SOFT CONTACT LENS PARAMETERS

Lens Brand:	ACUVUE® OASYS® Brand with HYDRACLEAR® PLUS
Lens Material:	Senofilcon A
Base curve:	8.4 mm
Diameter:	14.0 mm
Dk/t:	$1.47x10^{-7}$
Water content:	38%
UV blocker:	Class 1
Center thickness at -3.00 D:	0.070 mm
Center thickness at +3.00 D:	0.147 mm

*Information made publically available by Vistakon® at www.acuvueprofessional.com

APPENDIX B

IRB APPROVAL

Ferris State University

Institutional Review Board (FSU - IRB)
Office of Academic Research
Ferris State University
1201 S. State Street-CSS 310 H
Big Rapids, MI 49307
(231) 591-2553
IRB@ferris.edu

To: Dr. Dean Luplow
From: Dr. John Pole, Interim IRB Chair
Re: IRB Application #130709 (Title: *Effect of moderate powered soft contact lenses on results on rebound tonometry*)
Date: August 14, 2013

The Ferris State University Institutional Review Board (IRB) has reviewed your application for using human subjects in the study, "*Effect of moderate powered soft contact lenses on results on rebound tonometry*" (#130709) and approved it as *expedited – 2D* from full committee review. This approval has an expiration date of one year from the date of this letter. As such, you may collect data according to procedures in your application until *August 14, 2014.* It is your obligation to inform the IRB of any changes in your research protocol that would substantially alter the methods and procedures reviewed and approved by the IRB in this application. Your application has been assigned a project number (#130709) which you should refer to in future applications involving the same research procedure.

We also wish to inform researchers that the IRB requires follow-up reports for all research protocols as mandated by Title 45 Code of Federal Regulations, Part 46 (45 CFR 46) for using human subjects in research. We will send a one-year reminder to complete the final report or note the continuation of this study. The final-report form is available on the IRB homepage. Thank you for your compliance with these guidelines and best wishes for a successful research endeavor. Please let us know if the IRB can be of any future assistance.

Ferris State University

Doctor of Optometry Senior Paper

Library Approval and Release

THE EFFECT OF MODERATE POWERED SOFT CONTACT LENSES ON REBOUND TONOMETRY

We, Loren Baldus and Sarah Brozzo hereby release this Paper as described above to Ferris State University with the understanding that it will be accessible to the general public. This release is required under the provisions of the Federal Privacy Act.

[redacted]

Doctoral Candidate(s)

3-30-14

Date