

THE IMPACT OF CONTACT LENS WEAR ON INTRAOCULAR PRESSURE
MEASUREMENTS UTILIZING THE iCARE TONOMETER

by

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This paper is submitted in partial fulfillment of the
requirements for the degree of

Doctor of Optometry
Ferris State University
Michigan College of Optometry

May 2010

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Has been approved

May 2010

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ACCEPTED:

Faculty Course Supervisor

**Ferris State University
Doctor of Optometry Senior Paper
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ABSTRACT

Background : This research study aims to evaluate the effect of contact lenses have on intraocular pressure measurements using the iCare Tonometer. *Methods* : Intraocular pressure was measured six times in 50 eyes of healthy optometry students using the iCare Tonometer. The first three readings were taken without a contact lens on the eye. The second three readings were taken after a -2.00 diopter (D) Focus Dailies contact lens was inserted and allowed to settle on the eye for three minutes.

Results : There were no statistical or clinically significant difference found in the intraocular pressure measurements taken with the iCare Tonometer on eyes with -2.00 D contact lenses inserted compared to those eyes without the lenses. *Conclusion* : The iCare Tonometer is a quick, reliable method of evaluating intraocular pressure in contact lens wearers with mild amounts of myopia

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INTRODUCTION

The technology and clinical equipment available to optometrists today is quickly expanding to allow optometrists to give more advanced and comprehensive care to their patients on a daily basis. The measurement of intraocular pressure (IOP) is an important exam element in providing patients with a complete and thorough ocular health evaluation. These measurements are especially important in identifying those at an increased risk for developing various forms of glaucoma. Currently, the gold standard in obtaining this measurement is Goldmann Applanation Tonometry (GAT)^{1,2,3}. Other well-known and often used methods include non-contact Tonometry (NCT), Perkins tonometry, and Tonopen. NCT utilizes a pulse of air to conduct the measurement, which some patients find quite bothersome. The other methods involve instilling topical anesthetic and possibly other drops into the eye. All of the aforementioned IOP measurement techniques, except NCT, require contact lens wearing patients to remove their lenses before it can be performed, which can be time consuming to the examination process, especially if the visit is meant to be a routine or quick follow up visit. One study that was previously conducted found that using NCT on myopic patients wearing contact lenses that ranged in power from -3.00 D to -12.00 D showed a statistically significant difference in readings taken with the contact lenses on versus those without. IOP tended to be underestimated in readings taken over contact lenses and the disparity between readings increased with increasing lens power⁴.

One of the newest instruments on the market is the iCare Tonometer, which is a rebound tonometer (RT) that is able to obtain IOP measurements without the use of traumatic pulses of air or topical anesthetics. Although there are many research studies currently being performed concerning the iCare Tonometer, one aspect of the iCare Tonometer that has yet to be investigated is the effect of soft contact lenses on IOP measurements taken with this instrument. The goal of this particular study is to evaluate the effect of a -2.00 D soft daily wear contact lens on IOP readings in young, healthy adults. The hypothesis is that a -2.00 D soft contact lens will not have an effect on IOP measurements. If this hypothesis proves to be correct, it could allow practitioners to obtain IOP readings without having patients with mild myopia needing to remove their soft contact lenses. This would be beneficial as well as time-saving in those offices in which IOP measurements are part of pre-testing procedures. It could allow examiners to have more exam elements completed without requiring contact lenses to be removed or taking up valuable exam time performing pressures or removing/inserting contact lenses.

METHODS

Intraocular pressure measurements were collected from 50 eyes of healthy optometry students after informed consent (Appendix 1) had been obtained. To minimize deviation and obtain an overall average IOP, one reading using the iCare Tonometer involves six pressure measurements in rapid succession. The tonometer is then able to calculate and display the average measurement along with the statistical significance. We obtained a total of three complete and statistically sound measurements on each eye and recorded the results. Following this initial measurement, the subjects were given a -2.00 D Focus Dailies contact lens to insert on the eye. After an adaptation period of three minutes, three additional IOP measurements were taken on the eye with the contact lens. Successful measurements were obtained on all subjects and no discomfort was reported.

RESULTS

IOP measurements of the subjects ranged from 9 mmHg to 22 mmHg, both with and without contact lenses. The average reading in those eyes without contact lenses was 15.32 mmHg, while in those with contact lenses, the average was 14.75 mmHg. When reviewing the results, the repeatability of measurements obtained from the iCare Tonometer was first analyzed to ensure repeatability. A repeated measures analysis of variables (ANOVA) displayed no statistical difference ($p>0.05$) among the readings, therefore indicating that the results are, indeed, repeatable. Although the average IOP with contact lenses was lower it was found that there was no statistical difference ($p>0.05$) between the IOP measurements taken with contact lenses on and those taken without lenses. All average readings obtained can be found in Figure 1.

DISCUSSION

With over thirty million Americans wearing contact lenses all or at least part of the time, and with eighty percent of that number wearing soft lenses, it can be noted that the contact lens industry in the United States is quite extensive⁶. In optometry practices throughout the country, contact lens wearers make up an increasing percentage of the patient base and, with this increase, comes a need to streamline and gear the vision and health exam process towards these individuals when indicated. When looking at such exam elements, tonometry is one area that has always been an important aspect in providing patients with a complete ocular health examination. Applanation tonometry, as employed by the iCare Tonometer, subjects the cornea to enough force to be able to flatten a specific area. The amount of pressure exerted to flatten the cornea is then converted into a readable intraocular pressure measurement. Factors such as corneal thickness, corneal edema and even highly astigmatic eyes may lead to improper readings. As with Goldmann Tonometry, the iCare Tonometer is not immune to such irregularities and inconsistencies, which must be taken into account before determining an accurate IOP measurement⁷.

As previously mentioned, the iCare Tonometer is one of the newest instruments on the market that utilizes Rebound Tonometry (RT) to obtain intraocular pressure measurements without the need for pulses of air or topical anesthetic instillation. The design of this instrument includes a small probe made from Teflon material that touches the cornea gently and very briefly in the process of measuring IOP. The probe travels towards the cornea at a speed of 0.2 meters

per second and makes contact for approximately 30 milliseconds¹. Since the typical blink reflex occurs at about 0.2 seconds, this method of RT can obtain the IOP measurement before the blink reflex is induced¹. As the probe bounces off the cornea and returns to the instrument a measurement of the electrical induction current is obtained. The iCare tonometer uses this to calculate the deceleration of the probe after the measurement, this is then converted into an IOP measurement⁵. To minimize deviation and get an overall average IOP, it is suggested, but not necessary, to take 6 measurements per reading¹.

Previous research has shown that the iCare Tonometer may slightly overestimate IOP measurements when compared to Goldmann Tonometry^{1,2}, with a mean difference of 3.36 mmHg.² However, when compared to other methods of tonometry, IOP readings using the iCare tonometer tend to be similar¹. Some studies have also found the iCare to underestimate lower IOP values relative to GAT² and that the repeatability of results obtained with the iCare is less than that of GAT, but better than those of other portable tonometers¹. Some studies have found that patients with higher IOP readings show an even greater IOP reading when using the iCare compared with those readings obtained from Goldmann tonometry^{3,5}. One of the many benefits of using the iCare tonometer is its ease of use. In any busy office it would only take a few moments to properly train pre-testing staff how to use this instrument. While having the instrument properly positioned to measure IOP at the center of the cornea, one study found that taking IOP readings 3 millimeters temporally from the central cornea did not have a great effect on IOP measurements⁸. Another important finding in comparing iCare

to GAT is that the difference between the IOP readings tends to be higher in myopic eyes. Compared to GAT, RT (i.e. iCare) readings were greater by more than 2 mmHg in 17.9% of emmetropic eyes, 13.3% of hyperopic eyes, 7.6% of astigmatic eyes, and 34.5% of myopic eyes². Based on the findings of these previous studies, iCare Tonometry appears to be an important clinical tool, but its limitations must be considered and suspicious IOP measurements and/or high risk patients should have Goldmann Applanation Tonometry performed instead of or in addition to.

As mentioned previously, other studies have researched the effect of IOP readings taken over contact lenses using NCT, with statistically significant differences in IOP readings noted. One can only assume the discomfort experienced by a pulse of air directed towards an eye with a contact lens already on it. A benefit of the iCare tonometer is that the typical patient experiences no discomfort, whether the reading is taken with or without contact lenses. None of the patients in this study reported discomfort or any problems with the IOP measurement technique of the iCare Tonometer.

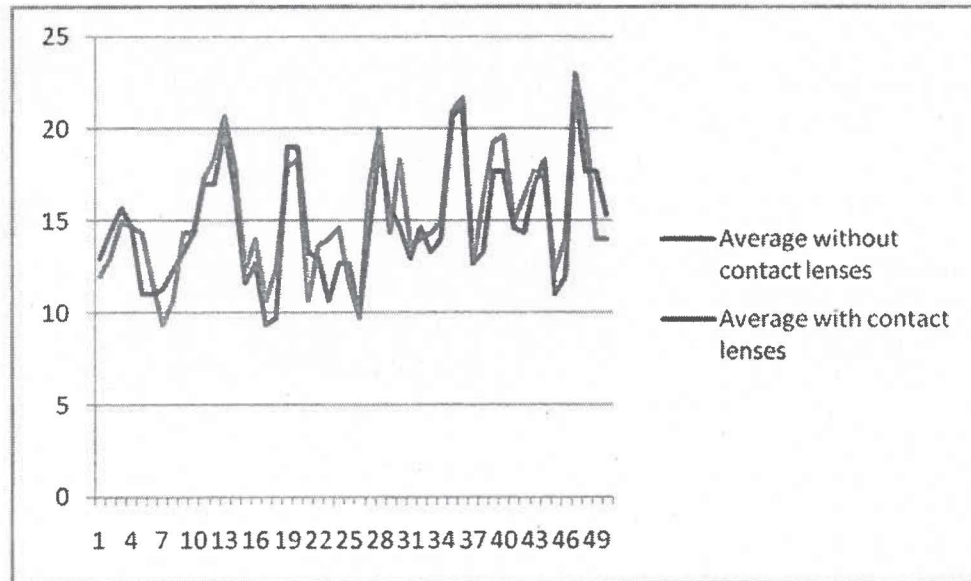
The iCare Tonometer proves beneficial in measuring intraocular pressure in all patients, including those with mild amounts of myopia. The ease of use, lack of anesthetic drops and efficiency makes it an ideal tool for pre-testing procedures within an office.

CONCLUSION

Based on the results obtained from this study, we are able to conclude that in patients with mild myopia, use of the iCare Tonometer over contact lenses will not produce a statistical or clinically significant difference in IOP measurement.

While the iCare Tonometer is a quick, convenient, and portable method of measuring IOP in all patients, Goldmann Applanation Tonometry is still the gold standard and should be employed when suspicious readings are obtained with other methods.

FIGURE 1: INTRAOCULAR PRESSURE MEASUREMENTS TAKEN WITH AND WITHOUT CONTACT LENSES



APPENDIX 1: STATEMENT OF INFORMATION AND INFORMED
CONSENT FOR RESEARCH PARTICIPANTS

SUBJECT INFORMATION AND INFORMED CONSENT

Study: **The impact of contact lens wear on intraocular pressure measurements utilizing the iCare tonometer.**

Investigators: **Erin Witte, Krista Bruni & Dr. James Miller
Michigan College of Optometry**

Before agreeing to participate in this study it is important you read the following explanation. The risks, benefits, precautions and your right to withdraw from the study at any time are outlined below. Please do not hesitate to ask questions on any unclear matters.

Explanation of Procedures:

This study is examining the effect of contact lens wear on intraocular pressure readings using the iCare tonometer. Individuals will have intraocular pressure readings taken on both eyes without any contact lenses. One contact lens will be placed on each of the participants eyes, will be allowed to settle for 5 minutes and readings will be re-taken. The total length of time for your participation will be about 15 minutes. No experimental procedures will be used in this study.

Risks and Discomfort:

Minimal serious risks or discomfort associated with this method of intraocular pressure readings. Slight discomfort may occur with insertion and removal of contact lenses.

Benefits:

The results of the study may influence the future use of the iCare tonometer in optometric practice in evaluating intraocular pressure readings taken over contact lenses.

Alternative Therapy:

If you choose not to take part in this study, no alternative therapy is necessary.

Costs and/or Payments to Subjects for Participation:

There will be no cost to be involved with this study nor will there be any payment made to participating subjects.

Confidentiality:

Any data obtained from this study will be kept personal and confidential. The results and measurements may be published for scientific purposes, however no personal information will be revealed.

Voluntary Participation/Withdrawal:

Your participation in this study is completely voluntary. You may withdraw from this study at any time.

Questions/Concerns:

Any questions you may have regarding this study can be directed to Krista Bruni, Erin Witte, or Dr. James Miller. Additional questions and/or concerns can be addressed to Connie Meinholdt, Chair, Human Subjects Research Committee, Ferris State University by phone: 231-591-2759 or by e-mail at HumanSubjectsResearchCommittee@ferris.edu

Statement of Consent:

I have read the above description of this research study. I have been informed of the risks and benefits involved, and all my questions have been answered to my satisfaction. Furthermore, I have been assured that any future questions I may have will also be answered by a Krista Bruni, Erin Witte, or Dr. James Miller. My signature below indicates I voluntarily agree to take part in this study.

Printed (Typed) Name of Subject

Subject's Signature

Date

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