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## Goldmann tonometry using Nikon's Tono Shields

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## Goldmann tonometry using Nikon's Tono Shields

### Abstract

Goldmann tonometry, the gold standard for measuring intraocular pressure, has several recommended methods for disinfection of the biprism. The methods approved by the Center for Disease Control include chemical disinfection with isopropyl alcohol, hydrogen peroxide or a dilute bleach solution. These chemicals should eliminate all potential infectious microorganisms if the disinfection procedure is performed properly. However, these same chemicals may cause structural damage to the biprism after prolonged usage, which could result in inaccurate readings. Nikon has posed a solution to this problem by creating the Tono Shield.™ The Tono Shield is a single use, disposable, silicone shield that is placed over the tip of the tonometer biprism for each intraocular pressure reading. The measurements taken with a Tono Shield are consistent and accurate to within  $\pm 1$  mmHg.

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Kenneth Eakland

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### Subject Categories

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**GOLDMANN TONOMETRY USING**

**NIKON'S TONO SHIELDS™**

**BY**

**ROSEMARY DETMER STONE**

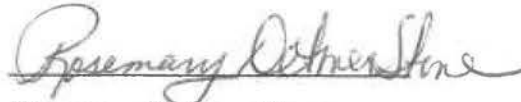
**GRETCHEN MUHLHAUSER**

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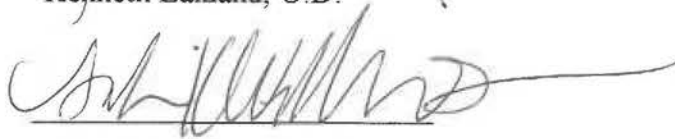
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Gretchen Muhlhauser is originally from Aberdeen, Washington. She attended Pacific Lutheran University, located in Tacoma, Washington, for her undergraduate studies. She continued on to Pacific University College of Optometry, graduating in May of 1996. Gretchen is currently in the United States Navy and is planning to practice in Pearl Harbor, Hawaii, following graduation

## **ABSTRACT**

Goldmann tonometry, the gold standard for measuring intraocular pressure, has several recommended methods for disinfection of the biprism. The methods approved by the Center for Disease Control include chemical disinfection with isopropyl alcohol, hydrogen peroxide or a dilute bleach solution. These chemicals should eliminate all potential infectious microorganisms if the disinfection procedure is performed properly. However, these same chemicals may cause structural damage to the biprism after prolonged usage, which could result in inaccurate readings. Nikon has posed a solution to this problem by creating the Tono Shield.<sup>TM</sup> The Tono Shield is a single use, disposable, silicone shield that is placed over the tip of the tonometer biprism for each intraocular pressure reading. The measurements taken with a Tono Shield are consistent and accurate to within  $\pm 1$  mmHg.

**KEY WORDS: Goldmann tonometry, Tono Shield, disinfection**

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## INTRODUCTION

Goldmann tonometry, a form of applanation tonometry, is widely accepted as the standard for measuring intraocular pressure (IOP)<sup>1</sup>. The accuracy of Goldmann tonometer measurements is of utmost importance for practitioners, especially those that routinely follow glaucoma or ocular hypertensive patients. Due to the necessity of this procedure, the majority of vision care practitioners routinely perform Goldmann tonometry, but may not thoroughly disinfect the tonometer biprism between patient use. A good disinfection method for the Goldmann biprism will prevent cross-contamination between patients. The disinfection process should remove or inactivate a contaminate, without damaging the equipment in the process.

As optometrists expand their scope of practice into the primary care sector, they must be made aware of the need for any and all universal precautions in their practices, for their patients' and their own safety as well. The risk of transferring many infectious diseases in an optometric office is a real concern.

In the past decade, there have been documented cases of outbreaks of epidemic keratoconjunctivitis (EKC) occurring in vision clinics as the result of having no uniform or efficient technique for Goldmann tonometer tip disinfection<sup>2,3</sup>. EKC is an acute follicular conjunctivitis that is highly contagious, and for which no specific therapy exists except for symptomatic treatment. The most common cause of EKC is Adenovirus 8, which is detectable in tears and has also been detected on Goldmann tonometer bprisms.<sup>2</sup>

Adenovirus 8 is not the only microbe that has been detected on the tonometer tips. There

are others, much more threatening, that can be transferred from patient to patient in a vision clinic if the practitioner is not cautious.

More recent studies have proven that other viruses such as Herpes Simplex Virus type I, can be transmitted via tonometer tips, if used consecutively without disinfection<sup>4</sup>. Two other possible virus transmissions that are of the utmost concern in all optometric offices are the Hepatitis B virus (HBV) and the Human T-cell Lymphotropic virus type III (HTLV-III) which is the etiologic agent of acquired immunodeficiency syndrome (AIDS). The HBV virus and HTLV-III have been isolated from tears and conjunctiva of infected persons<sup>5</sup>.

The incidence of Hepatitis B virus infection is increasing at an alarming rate. The Centers for Disease Control (CDC) reports that there are about 1,000,000 carriers of the Hepatitis B strain in the United States alone, thus meaning 1 in every 200 persons. Furthermore, the number of carriers is increasing 2-3 percent each year.<sup>6</sup> Strangely enough, the increased incidence of HBV is seen particularly among medical personnel.<sup>7</sup> It appears that only one-half of the new cases are caused by blood or blood products, which was thought to be the major mode of transmission. The other half of the cases of HBV are caused by respiratory, fecal-oral, and venereal methods of transmission.<sup>6,7</sup> Although there have not been any reported cases of transmission of the HBV in an optometric office, there are many studies that prove the HBV surface antigen is in the human tears and is viable on a tonometer tip if not disinfected properly.<sup>6-8</sup> Because of this reason, eye care practitioners are now included in the high risk category of contracting and/or transmitting HBV.<sup>6</sup>

Another infectious disease optometric professionals need to be aware of is AIDS. In a study performed by Fujikawa, et. al., the HTLV-III was isolated from the tears, and detected in the conjunctival epithelium of an AIDS patient.<sup>9</sup> The findings from this study alone are enough to raise questions and concerns of the possibility of transmitting the HTLV-III during ophthalmic examinations, specifically through an invasive procedure such as Goldmann tonometer usage.

There are several options that the Centers for Disease Control recommend for proper Goldmann tonometer disinfection. One method is to soak the tonometer tip for five minutes in a 1:10 diluted bleach solution or 3.0% hydrogen peroxide or 70% isopropyl alcohol.<sup>11,16</sup> All these methods are effective, but all have potential disadvantages for the practitioner and the patient. The disadvantages include possible incomplete disinfection and/or corneal toxicity due to incomplete rinsing of the disinfecting solution from the probe. The tonometer biprism may also have to be replaced more often because of the damage that can occur from using the chemical disinfection processes.<sup>11</sup> Due to the construction of the biprism, which is held together solely by glue, the chemical disinfection can disrupt the integrity of the biprism.<sup>12</sup> This disruption can cause irregularity or warpage in the biprism which can lead to inaccurate intraocular pressure measurements.<sup>11</sup>

An alternative for the Goldmann tonometer disinfection has recently been marketed. The Nikon Corporation has designed a disposable single use silicon cover, the Tono-Shield.<sup>TM</sup> The Tono Shield effectively prevents ocular fluids from coming in contact with the tonometer biprism. The Tono Shield is disposed of after each usage, thus eliminating

contamination of the tonometer or the patient. When the Tono-Shield is used properly, it can prevent disease transmission.

This study was designed to evaluate the accuracy of the IOP measurements taken with and without the placement of the Tono Shield on the Goldmann tonometer biprism amongst 57 subjects.

## **SUBJECTS**

The subjects recruited for the study were screened for any contraindications for the procedure. All of the subjects were reported to be in good health and have no known drug hypersensitivities. None of the subjects were taking any medications

## **PROCEDURE**

The methods conducted through the study were designed from the clinical trials protocol used by Nikon in the testing of the Tono-Shield.<sup>13</sup>

Two observers, both third year optometry students, performed the IOP measurements throughout the study. One hundred-fourteen eyes were evaluated with the Tono Shield. Prior to the measurement of the intraocular pressure, the following procedure was used: a complete anterior segment evaluation was performed via the use of the biomicroscope to determine the presence of any corneal defects, scars, and/or ocular infections which would contraindicate further involvement in the study. One drop of Fluress (a solution of sodium

fluorescein and benoxinate hydrochloride) was instilled in each eye to anesthetize the eye to reduce the blink rate and to evaluate any corneal staining which would also contraindicate the procedure.

For half of the eyes, the measured pressure was first performed without the use of the Tono Shield. The Tono Shield was then applied to the tonometer tip to remeasure the pressure in the same eye. For the remaining half of the eyes, the pressure was measured first with the use of the Tono Shield. Immediately following this measurement, the shield was removed and the pressure was again measured without the shield. After the final measurement, an assessment of the anterior segment was conducted to evaluate if any trauma was caused due to the procedure performed.

## **APPARATUS and MATERIALS**

The tonometry measurements were conducted at Pacific University College of Optometry Family Vision Clinic in Forest Grove, Oregon. The Haag-Streit Goldmann apparatus mounted on a Mentor biomicroscope in a clinic examination room was used throughout the study. The standard procedure for performing Goldmann applanation tonometry as written in Brandeth's book, *Clinical Slit Lamp Biomicroscopy*<sup>14</sup> was used. The two biprisms used were manufactured by the same company and were randomly assigned to a clinician.

## Results

The data collected for this study is summarized in Table 1. As expected, the measurements taken with the Tono Shield in place were slightly higher, resulting in an average pressure increase of 0.43 mmHg with a standard deviation of 0.707.

**Table 1. Intraocular Pressure Variances With TONO SHIELD**

<u>With Then Without</u>		<u>Without Then With</u>	
<b>I.O.P. Difference</b>	<b>Percentage</b>	<b>I.O.P. Difference</b>	<b>Percentage</b>
-3 mm Hg	1.8%	-1 mm Hg	5.4%
-2 mm Hg	10.7%	0 mmHg	58.9%
-1 mm Hg	19.6%	+1 mm Hg	21.4%
0 mm Hg	58.9%	+2 mm Hg	12.5%
+1 mm Hg	8.9%	+3 mm Hg	1.8%
<b>Average difference</b>	<b>-0.393</b>	<b>Average difference</b>	<b>0.464</b>
<b>Standard deviation</b>	<b>0.707</b>	<b>Standard deviation</b>	<b>0.707</b>

A Students paired t-test was used to determine if the intraocular pressure measured using a Tono Shield caused a significant increase in intraocular pressure. The t-test compared the measurements taken with the Tono Shield to those taken without the Tono Shield.

Based on the data compiled, there was no significant difference between these two groups ( $p < 0.05$ ). This indicates that the slight increase in intraocular pressure generated when the Tono Shield was used was not clinically significant. Rather, it was well within the standards for repeated applanation tonometry as reported by Leydhecker and colleagues.<sup>10</sup>

## DISCUSSION

Goldmann tonometer biperisms may not be adequately disinfected by current methods. Therefore, the advantages of using Nikon's Tono Shields as compared to chemical disinfection include added convenience and better protection from possible microorganism infection without potentially damaging the structure of the biprism.

The adenoviruses and the herpes simplex virus are common ocular microorganisms whose spread has been facilitated by inadequate cleaning techniques.<sup>15</sup> Many studies have reported that adenoviruses can be removed with the use of an isopropyl alcohol wipe, but it relies on the mechanical movement for complete disinfection.<sup>15</sup> It has also been reported that isopropyl alcohol wipes or hydrogen peroxide soaking are both effective in eliminating Herpes Simplex Virus types 1 and 2 from Goldmann tips.<sup>16</sup>

With the use of the Tono Shield, the risk of microbial spread is minimal. The biprism needs to be disinfected over its entire surface because of the possibility of secondary ocular infections.<sup>16</sup> However, rinsing the tips with a chemical disinfectant may cause corneal damage secondary to the chemical exposure.

It has been documented that isopropyl alcohol, hydrogen peroxide and 1:10 dilute bleach solution can disinfect Goldmann tonometer tips adequately if employed correctly. The Nikon Tono Shield is another choice practitioners now have for disinfection of the Goldmann tonometer. The Tono Shields allow for accurate IOP measurements and are a sanitary and convenient alternative method to repeated chemical disinfection. The overall

trend is for a slight increase in the reading of IOP measurements with the use of the cover. The variability of the measurements is consistent with the data reported for repeated measurements for Goldmann tonometry. With the accuracy of measuring intraocular pressure, the Tono Shield deserves further assessment. The advantages of this procedure in terms of safety, convenience, and cost are evident.

Preventative measures such as handwashing before and after patient contact as well as prior to handling of the tonometer tips will also decrease the risk of contamination. The passive transfer of infection is an issue not only for patients but for the medical staff as well.

## **CONCLUSION**

The Nikon Tono Shield accurately measures the intraocular pressure resulting in an average of less than 1.0 mmHg increase in pressure. The Tono Shield also serves as a reliable alternative to current methods of chemical disinfection for the Goldmann tonometer without jeopardizing the integrity of the biprism.



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