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Comparison of intra-ocular poessure with and without soft contact lenses using the non-contact tonometer and the tonopen

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Comparison of intra-ocular poessure with and without soft contact lenses using the non-contact tonometer and the tonopen

Abstract

The NCT and Tonopen have become popular tools for measuring IOP. It is not known whether accurate measurements can be taken while soft contact lenses are worn. IOP was measured with both instruments on patients with and without contact lenses. Both plus and minus 3.00 lenses were used on all subjects. Results indicate that soft contact lens wear will not affect measurement taken with the Tonopen. Minus soft contact lenses will not alter IOP taken by the NCT. Plus lenses, However, appear lo cause higher NCT readings than those taken without my lenses.

Degree Type

Thesis

Degree Name

Master of Science in Vision Science

Committee Chair

Patrick Caroline

Subject Categories

Optometry

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COMPARISON OF INTRA-OCULAR PRESSURE WITH AND
WITHOUT SOFT CONTACT LENSES USING THE NON-CONTACT
TONOMETER AND THE TONOPEN

By
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SALLY HACKING
SARAH KOEHN
SARA SCHULTZ
TERA UNZICKER-FASSERO

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
For the degree of
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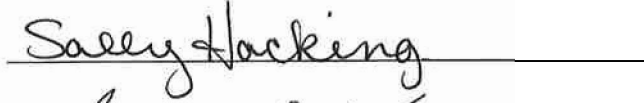
Advisor:
Patrick Caroline, C.O.T., F.A.A.O.

Authors:

Corey Becker

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Sally Backing

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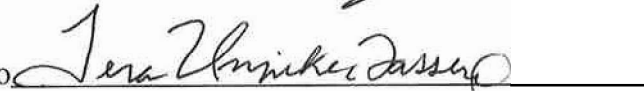
Sarah Koehn

Handwritten signature of Sarah Koehn in cursive script, written over a horizontal line.

Sara Schultz

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Tera Unzicker-Fassero

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Advisor:

Patrick Caroline, C.O.T., F.A.A.O.

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Corey Becker:

Corey Becker graduated as a Bachelor of Science in psychology from the University of North Dakota in 1997. He will be graduating from Pacific University College of Optometry in 2001. He is a member of Beta Sigma Kappa honors fraternity. He will be practicing as an optometrist for the United States Air Force upon graduation.

Sally Hacking:

Graduating from Madison High School out of Rexburg Idaho, in 1993, Sally was awarded a presidential scholarship to Ricks College. She then went on to Brigham Young University, graduating with a Bachelor of Science in Zoology. Sally is now at Pacific University College of Optometry. During optometry school she has received the All-American Collegiate Scholar, and is a member of Beta Sigma Kappa honor society, Sally also had two children during optometry school, and has a husband in dental school. She and her husband would eventually like to open an optometric/ dental clinic in Rexburg, Idaho. Perhaps it will have a nursery in the basement.

Sarah L Koehn:

Originally from McLaughlin, South Dakota, Sarah attended South Dakota State University and received a B.S. in Biology with a chemistry minor. She graduated with highest honors in the spring of 1997. She received several scholarships including South Dakota's most prestigious, The George S. Mickelson Academic Scholarship. She pursued her education at Pacific University College of Optometry and will be awarded her Doctor of Optometry degree in the spring of 2001. She hopes to return to South Dakota to practice optometry in a rural, private practice setting. Sarah's husband, Travis, is a middle school math teacher, and they have one daughter, Sydney and another due in May 2001.

Sara Schultz:

Sara graduated with a Bachelor's degree in Psychology from University of North Dakota in 1997. She also attended Minot State University and Pennsylvania State University. Now at Pacific University College of Optometry, Sara has served as class secretary, and been on several committees and boards. After graduation, in the spring of 2001, Sara would like to try living several different places, but eventually return to Minnesota.....within the next ten years. Sara has no husband, no kids, and no pets. She enjoys the outdoors, traveling, biking and running.

Tera Unzicker-Fassero

Tera received her Bachelor of Science from the University of Nebraska at Kearney in 1997. She was a member of the honors program and was on the Dean's list during her senior year. Now attending Pacific University College of Optometry, she plans on receiving her Doctorate of Optometry in 2001. Tera and her husband Dan would like to stay in the Mid-West or North-West United States. Tera plans on practicing in a private solo or group practice.

Abstract

The NCT and Tonopen have become popular tools for measuring IOP. It is not known whether accurate measurements can be taken while soft contact lenses are worn. IOP was measured with both instruments on patients with and without contact lenses. Both plus and minus 3.00 lenses were used on all subjects. Results indicate that soft contact lens wear will not affect measurement taken with the Tonopen. Minus soft contact lenses will not alter IOP taken by the NCT. Plus lenses, however, appear to cause higher NCT readings than those taken without any lenses.

INTRODUCTION

The non-contact tonometer has become an excellent tool for screening intra-ocular pressures. It is quite commonly used as a part of entrance testing, especially in larger optometric clinics. The ease of use is diminished however when a patient enters wearing contact lenses. The question arises whether the lenses should be removed or not. No one wants to risk accuracy but time constrictions can be very persuasive. Some practitioners ignore the lenses while others insist on their removal. Most would agree that leaving the lenses in place would increase efficiency, something optometrists all are striving for to ensure the productivity of their practices. Our intent is to answer this simple but important question.

The Tonopen is another popular method of measuring intra-ocular pressures. Its close correlation to Goldman Applanation Tonometry makes a good choice for measuring pressures in children and other Goldman sensitive patients. The ease of use also makes the Tonopen an ideal alternative to non-contact tonometry in entrance testing. In soft contact lens patients, no anesthesia would be required to perform the procedure. The Tonopen could therefore be used to determine IOP in the rare occurrence that a patient is allergic to available anesthetics.

The purpose of the project is to determine whether soft contact lenses affect intra-ocular pressure measurement. Literature review suggests inconclusive results about whether there is an effect¹⁻³⁻⁴. The past studies have also focused on therapeutic soft contact lenses rather than common refractive lenses²⁻⁵. It would be of practical value for optometrists to know if intra-ocular pressures could be measured with the patient's soft contact lenses in place. Intra-ocular pressure measurement could then be done as a part of entrance testing without removing soft contact lenses.

Methods

Subjects:

Thirty-five subjects were arranged to come in for approximately one 15-minute time-slot to participate in the study. Subjects were comprised entirely of optometry students. They were required to have no corneal abnormalities or allergies to anesthesia. No other requirements were deemed necessary since our purpose is only to compare the normal IOP to those taken with a contact lens in place.

Procedure:

All subjects had their IOP measured with industry standard instruments, the American Optical Non-Contact II Tonometer and the Tonopen. Due to the correlation of IOP between the eyes, only one eye on each patient was tested. Subjects were randomly selected as to whether their right or left eye would be tested. Each subject had IOP tested using both instruments with no contact lens in place. The pressures were then measured by the non-contact tonometer and the Tonopen with either a plus lens or minus lens in place and recorded. The opposite power lens was then used and the procedure was

repeated. All these procedures (no lens, plus lens, minus lens) were done on each subject but not necessarily in the order stated to randomize the experiment.

Acuvue contact lenses with a base curve of 8.4 were chosen as the soft lens for this study due to good fitting properties of the lens. The powers of the lenses were +3.00 and -3.00. The center thicknesses are 0.17mm for the +3.00 and 0.07mm for the -3.00. The soft contact lenses are FDA- approved and very commonly prescribed for patients.

A-NOVA repeated measures were used for statistical analysis for both the Tonopen and NCT results. Further analysis of the NCT results was deemed necessary, so the Sheffe Post Hoc with $P=0.10$ was used⁶.

Results

Thirty-six patients were recruited for the study, although one was selected out because of being a statistical outlier (IOP's of 1 and 2 mm Hg were obtained). Patients ages ranged between 18 and 35 years old.

There was no statistical difference (ANOVA repeated measures, $p = 0.2507$) found between measures using the Tonopen with patients who either wore the +3.00 lens, -3.00 lens or no lens at all. Using the Non-Contact Tonometer, however, there was a statistical difference (ANOVA repeated measures, $p < 0.0001$) indicated between IOP measurements with and without contact lenses on the eye.

Because there was a statistical difference found with IOP measurements using the NCT on patients with and without soft contact lenses, post hoc testing was performed. This was done to explore if the difference in IOP measurements was specific to either power of the contact lenses. The Sheffe Post Hoc test, which uses $p = 0.10$, indicated that there was no statistical difference between measurements while wearing -3.00 lenses and no lenses on the eye while using the NCT. A statistical difference was found ($p = 0.0567$), however, between +3.00 lenses and no lenses⁶.

Discussion

Our findings indicate that soft contact lens wear will not alter IOP measurements when taken with the Tonopen. With the NCT, the only significant findings involved plus contact lenses, in that the IOP tended to be high when compared to the same subject's readings without lenses. Minus soft contact lenses did not statistically alter the measurements by NCT.

Based on this study we conclude that prior to measuring IOP with NCT, soft contact lenses should be removed when a patient wears moderate to high plus powered lenses. However, minus soft contact lenses need not be removed before IOP measurements are taken with the NCT. IOP measurements will be accurate on patients wearing low to moderate powered soft contact lenses with the Tonopen.

References

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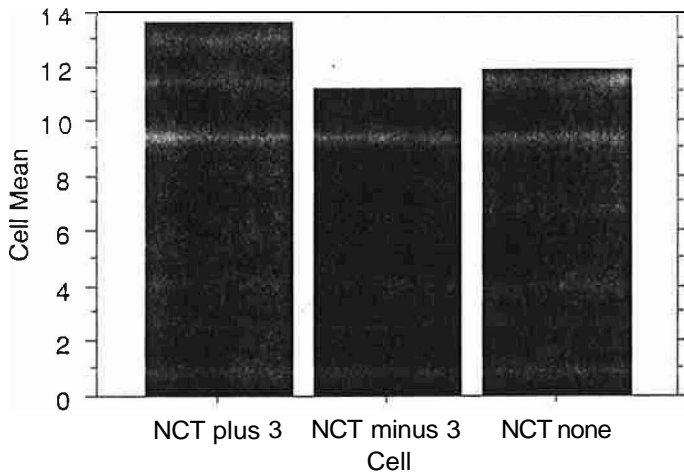
ANOVA Table for NCT

| | DF | Sum of Squares | Mean Square | F-Value | P-Value | Lambda | Power |
|----------------------------|----|----------------|-------------|---------|---------|--------|-------|
| Subject | 34 | 693.181 | 20.388 | | | | |
| Category for NCT | 2 | 109.200 | 54.600 | 12.976 | <.0001 | 25.952 | .999 |
| Category for NCT • Subject | 68 | 286.133 | 4.208 | | | | |

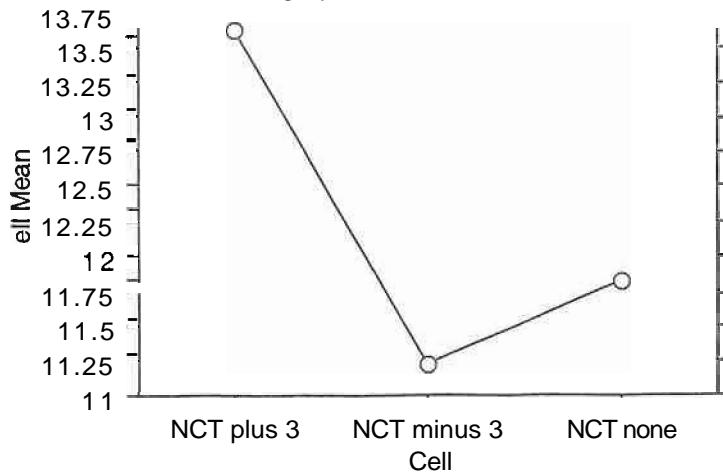
Means Table for NCT
Effect: Category for NCT

| | Count | Mean | Std. Dev. | Std. Err. |
|-------------|-------|--------|-----------|-----------|
| NCT plus 3 | 35 | 13.629 | 2.734 | .462 |
| NCT minus 3 | 35 | 11.229 | 3.549 | .600 |
| NCT none | 35 | 11.829 | 2.955 | .500 |

Interaction Bar Plot for NCT
Effect: Category for NCT



Interaction Line Plot for NCT
Effect: Category for NCT



Fisher's PLSD for NCT
 Effect: Category for NCT
 Significance Level: 5 %

| | Mean Diff. | Crit. Diff. | P-Value |
|-------------------------|------------|-------------|---------|
| NCT plus 3, NCT minus 3 | 2.400 | 1.469 | .0016 |
| NCT plus 3, NCT none | 1.800 | 1.469 | .0168 |
| NCT minus 3, NCT none | -.600 | 1.469 | .4198 |

Scheffe for NCT
 Effect: Category for NCT
 Significance Level: 5 %

| | Mean Diff. | Crit. Diff. | P-Value | |
|-------------------------|------------|-------------|---------|---|
| NCT plus 3, NCT minus 3 | 2.400 | 1.840 | .0068 | S |
| NCT plus 3, NCT none | 1.800 | 1.840 | .0567 | |
| NCT minus 3, NCT none | -.600 | 1.840 | .7211 | |

Bonferroni/Dunn for NCT
 Effect: Category for NCT
 Significance Level: 5 %

| | Mean Diff. | Crit. Diff. | P-Value | |
|-------------------------|------------|-------------|---------|---|
| NCT plus 3, NCT minus 3 | 2.400 | 1.803 | .0016 | S |
| NCT plus 3, NCT none | 1.800 | 1.803 | .0168 | |
| NCT minus 3, NCT none | -.600 | 1.803 | .4198 | |

Comparisons in this table are not significant unless the corresponding p-value is less than .0167.

Dunnnett for NCT
 Effect: Category for NCT
 Significance Level: 5 %

| | Mean Diff. | Crit. Diff. | |
|-------------|------------|-------------|---|
| NCT plus 3 | 1.800 | 1.666 | S |
| NCT minus 3 | -.600 | 1.666 | |

Tukey/Kramer for NCT
 Effect: Category for NCT
 Significance Level: 5 %

| | Mean Diff. | Crit. Diff. | |
|-------------------------|------------|-------------|---|
| NCT plus 3, NCT minus 3 | 2.400 | 1.766 | S |
| NCT plus 3, NCT none | 1.800 | 1.766 | S |
| NCT minus 3, NCT none | -.600 | 1.766 | |

Games/Howell for NCT
 Effect: Category for NCT
 Significance Level: 5 %

Mean Diff. Crit. Diff.

| | | |
|-------------------------|-------|-------|
| NCT plus 3, NCT minus 3 | 2.400 | 1.819 |
| NCT plus 3, NCT none | 1.800 | 1.634 |
| NCT minus 3, NCT none | -.600 | 1.875 |

Student-Newman-Keuls for NCT

Effect: Category for NCT

Significance Level: 5 %

| | Mean Diff. | Crit. Diff. | |
|-------------------------|------------|-------------|---|
| NCT plus 3, NCT minus 3 | 2.400 | 1.766 | S |
| NCT plus 3, NCT none | 1.800 | 1.471 | S |
| NCT minus 3, NCT none | -.600 | 1.471 | |

ANOVA Table for Tonopen

| | DF | Sum of Squares | Mean Square | F-Value | P-Value | Lambda | Power |
|--------------------------------|----|----------------|-------------|---------|---------|--------|-------|
| Subject | 34 | 555.390 | 16.335 | | | | |
| Category for Tonopen | 2 | 8.533 | 4.267 | 1.412 | .2507 | 2.824 | .282 |
| Category for Tonopen * Subject | 68 | 205.467 | 3.022 | | | | |

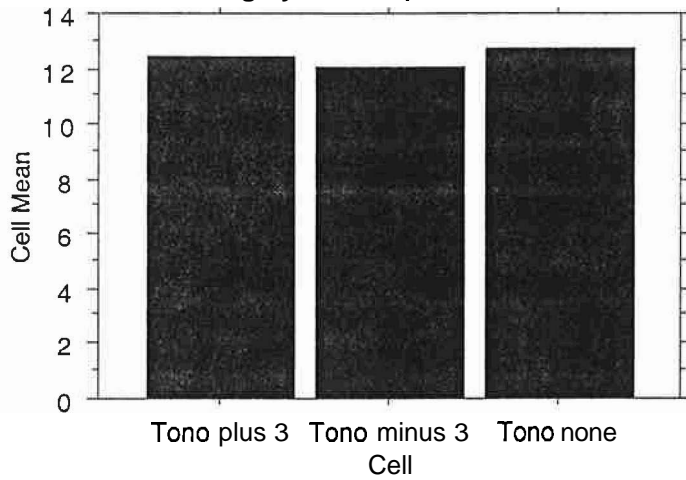
Means Table for Tonopen

Effect: Category for Tonopen

| | Count | Mean | Std. Dev. | Std. Err. |
|--------------|-------|--------|-----------|-----------|
| Tono plus 3 | 35 | 12.486 | 3.033 | .513 |
| Tono minus 3 | 35 | 12.029 | 2.358 | .398 |
| Tono none | 35 | 12.714 | 2.761 | .467 |

Interaction Bar Plot for Tonopen

Effect: Category for Tonopen



| | Tonopen | | | NCT | | |
|----|-------------|--------------|-----------|------------|-------------|----------|
| | Tono plus 3 | Tono minus 3 | Tono none | NCT plus 3 | NCT minus 3 | NCT none |
| 1 | 7 | 9 | 8 | 9 | 5 | 7 |
| 2 | 13 | 14 | 14 | 12 | 12 | 13 |
| 3 | 12 | 11 | 14 | 8 | 9 | 9 |
| 4 | 14 | 14 | 13 | 15 | 9 | 12 |
| 5 | 12 | 9 | 11 | 11 | 8 | 10 |
| 6 | 7 | 9 | 9 | 16 | 6 | 6 |
| 7 | 9 | 9 | 14 | 12 | 9 | 10 |
| 8 | 14 | 14 | 13 | 19 | 14 | 16 |
| 9 | 13 | 15 | 10 | 13 | 12 | 13 |
| 10 | 14 | 12 | 16 | 15 | 13 | 19 |
| 11 | 12 | 15 | 10 | 11 | 9 | 13 |
| 12 | 13 | 12 | 12 | 12 | 8 | 9 |
| 13 | 7 | 8 | 10 | 10 | 9 | 9 |
| 14 | 8 | 10 | 10 | 15 | 13 | 13 |
| 15 | 12 | 10 | 12 | 8 | 6 | 9 |
| 16 | 17 | 15 | 14 | 17 | 15 | 10 |
| 17 | 12 | 14 | 14 | 15 | 18 | 14 |
| 18 | 9 | 13 | 10 | 13 | 10 | 11 |
| 19 | 10 | 10 | 10 | 13 | 9 | 10 |
| 20 | 17 | 15 | 14 | 15 | 11 | 14 |
| 21 | 11 | 8 | 12 | 15 | 10 | 10 |
| 22 | 17 | 13 | 15 | 12 | 12 | 12 |
| 23 | 16 | 15 | 15 | 14 | 18 | 15 |
| 24 | 16 | 15 | 17 | 14 | 10 | 11 |
| 25 | 14 | 14 | 11 | 13 | 10 | 8 |
| 26 | 14 | 11 | 13 | 17 | 9 | 9 |
| 27 | 15 | 14 | 14 | 13 | 14 | 13 |
| 28 | 17 | 11 | 22 | 16 | 14 | 18 |
| 29 | 11 | 10 | 10 | 13 | 12 | 14 |
| 30 | 14 | 11 | 13 | 19 | 16 | 15 |
| 31 | 9 | 10 | 11 | 17 | 8 | 14 |
| 32 | 10 | 10 | 11 | 11 | 8 | 9 |
| 33 | 12 | 12 | 12 | 15 | 18 | 14 |
| 34 | 17 | 15 | 14 | 16 | 18 | 13 |
| 35 | 12 | 14 | 17 | 13 | 11 | 12 |
| | | | | | | |

| | Tonopen | | | NCT | | |
|----------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | Tono plus 3 | Tono minus 3 | Tono none | NCT plus 3 | NCT minus 3 | NCT none |
| ▶ Type: | Integer | Integer | Integer | Integer | Integer | Integer |
| ▶ Source: | User Entered | User Entered | User Entered | User Entered | User Entered | User Entered |
| ▶ Class: | Continuous | Continuous | Continuous | Continuous | Continuous | Continuous |
| ▶ Format: | • | • | • | • | • | • |
| ▶ Dec. Places: | • | • | • | • | • | • |
| Mean: | 12.486 | 12.029 | 12.714 | 13.629 | 11.229 | 11.829 |
| Std. Deviation: | 3.033 | 2.358 | 2.761 | 2.734 | 3.549 | 2.955 |
| Std. Error: | .513 | .398 | .467 | .462 | .600 | .500 |
| Variance: | 9.198 | 5.558 | 7.622 | 7.476 | 12.593 | 8.734 |
| Coeff. of Variation: | .243 | .196 | .217 | .201 | .316 | .250 |
| Minimum: | 7 | 8 | 8 | 8 | 5 | 6 |
| Maximum: | 17 | 15 | 22 | 19 | 18 | 19 |
| Range: | 10.000 | 7.000 | 14.000 | 11.000 | 13.000 | 13.000 |
| Count: | 35 | 35 | 35 | 35 | 35 | 35 |
| Missing Cells: | 0 | 0 | 0 | 0 | 0 | 0 |
| Sum: | 437.000 | 421.000 | 445.000 | 477.000 | 393.000 | 414.000 |
| Sum of Squares: | 5769.000 | 5253.000 | 5917.000 | 6755.000 | 4841.000 | 5194.000 |