

Accuracy of tonometry over soft contact lenses using Tono-Pen XL

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Purpose: To evaluate the accuracy of intraocular pressure (IOP) measurements taken through a commonly used soft contact lens using Tono-Pen.

Methods: Measure the IOP of fifty eyes using Tono-Pen. A myopic soft contact lens (Biomedics 38's) was placed on the eyes and IOP measurements were taken through the soft contact lenses. The readings obtained for the contact lens were compared to the baseline readings taken without a lens in place in order to assess the effect that the contact lens had on the accuracy of IOP measurements.

Results: The contact lens permitted accurate IOP measurements. The mean IOP (\pm SD) taken through the soft contacts was 11.87 ± 2.58 mm Hg. The mean baseline IOP was 12.25 ± 2.97 mm Hg. The difference between the mean was found to be insignificant with a p-value = .12.

Conclusion: Tono-pen proved to be reliable in recording accurate IOP measurements through a myopic contact lens.

Introduction

Soft contact lenses are widely used in the correction of refractive error and, more recently in the treatment of corneal diseases. As bandage lenses, soft contacts play a significant role in protecting the cornea and relieving pain. For many patients, an accurate method of determining the IOP without removing the contact lens is highly desirable. Scibilia et. al. tested the effect of three different therapeutic contact lenses on IOP measurements and found all three permitted accurate IOP measurements. Variations in water content and central thickness did not affect the accuracy of IOP measurements done with Tono-Pen, Goldmann applanation tonometry and pneumatonometry.(1)

More recently researchers have looked at the accuracy of IOP measurements taken through corrective soft contact lenses. The evaluation of IOP reliability when pressure readings were taken over hyperopic and myopic lenses has been reported in previous studies. (2,3) Studies have shown that values in eyes with myopic lenses correlated better than the values obtained from eyes with hyperopic lenses when compared to pressure measurements obtained without a contact lens. They found that when the center thickness of the soft contact lens exceeded .45mm that accuracy of the pressure readings became inaccurate.

Mok et al. compared IOP measurements taken at the central cornea with those taken at the mid-periphery. (4) There was no significant difference between the IOP readings of central and mid-peripheral cornea measured by the Tono-Pen. In the study done by Mok et al. the difference in mean corneal thickness between the central and mid-peripheral cornea was 40 μ m. Therefore, a soft lens with a central thickness of 40 μ m would be ideal for this study because it would mimic the increase in thickness from central to midperipheral cornea. And also because a center thickness of 40 μ m is just slightly under the center thickness, 45 μ m, at which inaccurate readings were found to occur in the study by Krieglestein et al. (3). The Ocular Sciences' Biomedics 38 fit

this requirement perfectly. It also is made of polymacon a material common to many soft lenses.

This study attempts to assess the accuracy of IOP measurements taken through a soft contact lens with a center thickness of .040mm. If the contact lens had the same tensile strength as the human cornea then doing applanation tonometry over the lens should increase the IOP measured. Ehlers and associates found that for every 70µm increase in central corneal thickness a 5 mmHg rise in IOP was observed. (9) Using this data to extrapolate a contact with center thickness of 40µm would lead to an increase in IOP of 2.8 mmHg. In this study, the mean baseline IOP and IOP measured over the contact lenses differed by only .38 mmHg. The mean IOP of taken over the contacts was actually lower than the baseline IOP. This difference was found to be statistically insignificant with a p value = .12. So clearly the relationship between corneal thickness and IOP cannot be extended to soft contact lenses probably because the corneal stroma and hydrogel soft lens materials don't have the same tensile strength.

Materials

Tono-Pen XL uses an internal calibration system and provides measurements readings by digital display. The Tono-Pen XL utilizes a microstrain gauge located at its tip which averages anywhere from four to ten measurements before any value is displayed on the units LCD. The LCD shows the IOP value and a level of confidence which it calculates depending on the range of the averaged samples. The Tono-Pen was calibrated before each new day of testing.

The specifications for the contacts used in this study are listed in Table 1.

Soft lens	Power	Water content	Center thickness
Biomedics 38s	-3.00	62%	.040mm

Methods

Twenty five subjects ranging in age from 19 to 52 volunteered for this study. Twenty were female and five male. None of the subjects were being treated for glaucoma or were known glaucoma suspects. Any patient with altered corneal thickness, corneal dystrophies or degenerations was excluded from the study. These include patients who had undergone LASIK, LTK, PRK or any other laser procedures that alter corneal thickness. Anyone with latex allergy or known sensitivity to proparacaine was also excluded from the study. After the risk benefit statement was read and a consent form signed the contact lenses were inserted. A time of one minute was allowed to elapse before the first pressure measurements were taken. Every patient recruited for this study was assigned a number to randomize which eye was tested first. The odd numbered patients had the left eye tested before the right and vice versa for the even numbered patients. The pressure readings taken through soft contacts didn't require the use of any anesthetic. After the first set of IOP readings had

been obtained, the soft lenses were removed. One drop of proparacaine was then applied in each eye before the baseline readings were taken.

Tono-Pen readings weren't considered valid unless they were within the 95% confidence level. If excess blinking was encountered the lids were held with care as to not apply pressure to the globe. Care was also taken to only touch the Tono-pen tip to the central cornea. All measurements were taken by one examiner using the same instrument. The examiner had performed Tono-Pen applanation tonometry on over 200 patients prior to the study.

Results

The mean IOP measurements (\pm SD) taken through soft contacts was 11.87 ± 2.58 mm Hg. The mean measurements for the Tono-Pen without a lens was 12.25 ± 2.97 mm Hg. The paired t-Test (2,49) showed no significance between the two compared means, $t = -1.57$. A summary of the statistical analysis is shown in Table 2. Chart 1 shows graphical representation of the two sets of collected data.

	IOP over contacts	Baseline IOP
Mean	11.88	12.25
Std. Dev.	2.58	2.97

Table 2: Summary of Statistical analysis comparing measurements with and without soft contact lenses.

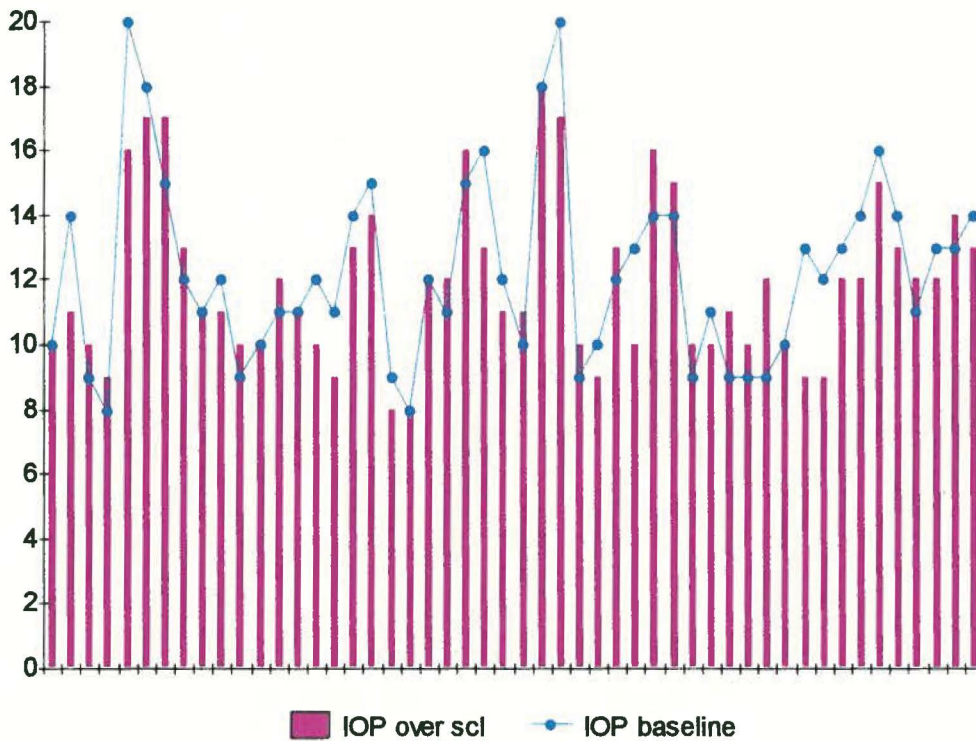


Chart 1: comparison of data acquired on 50 eyes.

On three subjects, a confidence level of 10% was initially displayed. A confidence level of 5% was acquired from all three with repeated applanation. Rarely was it necessary to hold a subjects lids.

Discussion

This study evaluated the accuracy of IOP measurements by Tono-Pen XL in healthy corneas compared to measurements with the same instrument through a given myopic soft contact lens. Tonopen has been shown to correlate well with Goldmann applanation tonometry for IOPs between 10 and 30mm Hg. IOPs lower than 10mm Hg tend to be slightly overestimated with the Tono-Pen when compared to Goldmann applanation tonometry. IOPs over 30 have been shown to be slightly underestimated with the Tono-Pen when compared to Goldmann. However most studies comparing the two methods, conclude that Tono-Pen is accurate enough to be well suited for IOP screening.(5,6)

In this study, all of the IOP measurements taken over contact lenses were acquired before the baseline readings. This was done so that no contacts were applied to an anesthetized corneas. What factor this played in the results is unclear.

One advantage of being able to estimate IOP over contact lenses is that no stain is needed so there is nothing to be absorbed into the contacts. Also this type of IOP measurement could be performed on patients with known reactions to corneal anesthetics or stains if a non-contact tonometer is not available.

In many practices, soft contact lenses designed for the correction of refractive error are used as bandage lenses. Usually a contact lens with minimal power is chosen. A -.50 diopter contact lens is a typical choice. The thickness of most low powered minus soft lenses are thinner than the soft lens used in this study and therefore should facilitate accurate IOP measurements. Leaving a bandage lens on the eye while taking tonometry measurements not only saves time, but it is also more comfortable for the patient and arguably healthier for the cornea. Unless great care is taken to irrigate and decenter therapeutic lenses before their removal a small area of cornea can be peeled away.

It is recommended that when evaluating IOP in children or patients with poor fixation that the patients lids be held against the brow. When holding lids while using the Tono-Pen sometimes falsely high pressures is manifested. In those instances when a suspiciously high IOP value is encountered and the lids are being held it becomes necessary to repeat the measurements. It is recommended that the lowest readings are the most accurate.(7)

The Tono-Pen is useful with patients who have undergone PRK vision correction. Because the Tono-Pen's micro-strain gauge at the tip of the unit is so small it can be used on non-ablated, peripheral cornea, with better reliability than Goldmann which is done on an area of altered corneal thickness. It is important to recognize that IOP measured in the central corneal region after PRK may be falsely low. Myopic patients are more prone to develop glaucoma, and many of them could be steroid responders.(8)

Tono-Pen is also well suited for patients with moderate to advanced keratoconus. IOP in these patient populations is often difficult to assess with Goldmann applanation tonometry due to the distortion of the mires. When using the Tono-Pen with these patients care can be taken not to applanate near areas of corneal thinning or scarring.

Conclusion

Tono-Pen proved to be reliable in recording accurate IOP measurements through myopic soft contact lenses.

Acknowledgments

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