# Relationship Between Scleral Lenses and Intraocular Pressure

Abigail Zielke BS, Sarah Ellison BS, and Joshua Lotoczky OD, FAAO; Michigan College of

FERRIS STATE UNIVERSITY

MICHIGAN COLLEGE OF OPTOMETRY

## Introduction

- Recently, there have been concerns raised about whether or not scleral lens wear affects intraocular pressure (IOP).
- Some mechanism theories include episcleral vein compression, trabecular meshwork and anterior chamber angle narrowing, and suction forces produced by the scleral lens.
- Previous studies have utilized varying methods including Diaton tonometry, pneuomotonometry, and I-Care tonometry.
- This study investigates the influence of scleral lens wear on IOP by testing two different lens diameters and measuring with Goldmann Applanation tonometry.

## Methods

- Twenty student participants were selected from Michigan College of Optometry staff, faculty and students.
- Patient demographic was 25% Caucasian males and 75% Caucasian females, with no pre-existing ocular conditions besides refractive error.
- Baseline Goldmann tonometry was conducted on both eyes.
- Right eye was fit with 15.5 mm Art Optical Ampleye scleral lens with toric periphery from fitting set. The left eye functioned as the control eye and did not wear a lens.
- Proper lens fit was evaluated with slit lamp. Participants who did not achieve acceptable fit using fitting set were excluded from study.
- Assuming proper fit, lens was worn on right eye for four hours. Patient returned following four hours to have lens removed.
- Goldmann Tonometry was performed immediately following lens removal on both eyes and again at 30 minutes post-removal.
- A second wear period was conducted with a 16.5 mm diameter lens following identical procedures.

## Results

- By Wilcoxon Signed Rank Test, comparing the control to test eye reveals there was a statistically significant difference between the mean ranks of IOP in the control eye (mean rank 11.53) and the mean ranks of IOP in the right eye (mean rank 6.00), with a very large effect size of 0.88.
- This reveals that after four hours of wear, IOP in the right test eye was higher compared to the control left eye.
- Using the same test, the post removal 30-minute control eye was compared to the test eye. This test did not find a statistically significant difference. This shows that any difference of IOP during the 4 hour wear time was no longer affecting pressure after 30 minutes of wear.
- A Mann-Whitney U test was performed to compare the 15.5 mm and 16.5 mm lens. There was no statistical difference between the two lenses, with the exception of 30 minutes post removal. At 30 minutes post removal, the 15.5 mm test eye was lower than the IOP in the eye that wore the 16.5 mm lens.

| | 15.5 mm Diameter | | | 16.5 mm Diameter | | |
|---|---|---|---|---|---|---|
| Subject | Pre-Lens IOP Difference | Post-Lens IOP Difference | Overall Increase in IOP from Lens Wear | Pre-Lens IOP Difference | Post-Lens IOP Difference | Overall Increase in IOP from Lens Wear |
| 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| 2 | 1 | 3 | 2 | 1 | 2 | 1 |
| 3 | -1 | 0 | 1 | 3 | 2 | -1 |
| 4 | 1 | 2 | 1 | 2 | 1 | -1 |
| 5 | 1 | 0 | -1 | 0 | 2 | 2 |
| 6 | -1 | 0 | 1 | 2 | 0 | -2 |
| 7 | 0 | 2 | 2 | -2 | 0 | 2 |
| 8 | 1 | 1 | 0 | 1 | 2 | 1 |
| 9 | -2 | 1 | 3 | 0 | 2 | 2 |
| 10 | 1 | 0 | -1 | 0 | -1 | -1 |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | -1 | 1 | 2 | 0 | 1 | 1 |
| 13 | 1 | 0 | -1 | -1 | 0 | 1 |
| 14 | 2 | 0 | -2 | 0 | 4 | 4 |
| 15 | 1 | 0 | -1 | 0 | 0 | 0 |
| 16 | 1 | 0 | -1 | 1 | 1 | 0 |
| 17 | 2 | 0 | -2 | 0 | 1 | 1 |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 | 2 | 1 | -1 | 0 | 2 | 2 |
| 20 | -2 | 0 | 2 | -3 | -1 | 2 |
| | | Average Increase: | 0.2 | | Average Increase: | 0.75 |

Table 1 illustrates the pre-lens wear IOP difference, post-lens wear IOP difference and the overall increase in IOP found in the right eye. A negative number found in the chart above indicates that the pressure in the right eye decreased, while a positive number indicates an increase in IOP in the right eye. Overall, there was an increase in IOP with the 15.5 mm and 16.5 mm diameter lens.

## Conclusions

- After four hours of wear there was a statistically significant difference in IOP for both lens diameters—the average increase in IOP was 0.2 mmHg and 0.75 mmHg (15.5 and 16.5 diameters, respectively)
- After 30 minutes post removal, there was not a statistical difference in IOP between the two eyes in either lens diameter. This shows the rise in IOP was transient.
- There was no significant difference in IOP rise between the two different lens diameters.
- Although statistically significant, the clinical significance of this IOP rise is questionable.

## References

1. Vincent S. The rigid lens renaissance: A surge in sclerals. *Cont Lens Ant Eye* 2018; 41(2): 139–43.

2. McMonnies CW. A hypothesis that scleral contact lenses could elevate intraocular pressure. *Clin Exp Optom* 2016; 99 (6): 594-96.

3. McMonnies CW, Boneham GC. Experimentally increasing intraocular pressure, using digital forces. *Eye Cont Lens* 2007; 33: 124-29.

4. Joos KM, Kay MD, Pillunat LE, Harris A, Gendron EK, Feuer WJ et al. Effect of acute intraocular pressure changes on short posterior ciliary artery haemodynamics. *Br J Ophthalmol* 1999; 83: 33-38.

5. Kasetsuwan N, Pangilinan RT, Moreira LL, DiMartino DS, Shah SS, Schallhorn SC et al. Real time intraocular pressure and lamellar corneal flap thickness in keratomileusis. *Cornea* 2001; 20: 41-44.

6. Vincent S, Alonso-Caneiro D, Collins M. The temporal dynamics of miniscleral contact lenses: Central corneal clearance and centration. *Cont Lens Anterior Eye* 2018; 41 (2): 162-68.

7. Kauffman M, Gilmartin C, Bennett E, Bassi C. A comparison of the short-term settling of three scleral lens designs. *Optom Vis Sci* 2014; 91 (12): 1462-66

8. Aitsebaomo AP, Wong-Powell J, Miller W, Amir F. Influence of scleral lens on intraocular pressure. *J Cont Lens Res Sci* 2019; 3 (1): e1-e9.

9. Michaud L, Samaha D, Giasson C. Intra-ocular pressure variation associated with the wear of scleral lenses of different diameters. *Cont Lens Anterior Eye* 2018; 42: 104-10.

10. Nau CB, Schornack MM, McLaren JW, Sit AJ. Intraocular pressure after 2 hours of small-diameter scleral lens wear. *Eye Contact Lens* 2016; 42 (6): 350-53.

11. Hugert A. Increase of the intraocular pressure when using contact glasses. *Acta Ophthalmol* 1951; 29 (4): 475-81.

12. Turpin S, Antoniuk K, Caroline P, Kojima R, Kinoshita B, Lampa M et al. Does IOP Increase During Scleral Lens Wear. Poster presentation at the 2018 Global Specialty Lens Symposium, Jan. 2018, Las Vegas.

13. Zhang XR, Zhang ZY, Hoffman MR et al. The effect of age and conjunctivochalasis on conjunctival thickness. *Curr Eye Res* 2013; 38: 331-34.

14. Visser ES, Visser R, Van Lier HJ. Advantages of toric scleral lenses. *Optom Vis Sci* 2006; 83 (4): 233-36.

15. Ozcura F, Yildirim N, Sahin A, Colak E. Comparison of goldmann applanation tonometry, rebound tonometry and dynamic contour tonometry in normal and glaucomatous eyes. *Int J Ophthalmol* 2015; 8 (2): 299-304.

## Acknowledgements

- We would like to acknowledge Dr. Joshua Lotoczky for guidance on this project, as well as Dr. Robert Buckingham for his statistical analysis contributions