OC-SAG values in 360 degrees

Javier Rojas[1], Eef van der Worp[2], David Piñero[3]

Centro de Lentes de Contacto

Universitat d'Alacant
Universidad de Alicante

Introduction

Generating information about the overall sagittal height of the anterior eye (OC-SAG) is gaining more attention lately in the contact lens field. Initially as a major contributor to fit scleral lenses, it is now used to better understand soft lens fitting and soft lens behavior on-eye.[1,2] What is of utmost importance, is to understand the differences that exist in various meridians on that ocular surface.[3] The average OC-SAG in a 360-degree fashion most likely will provides the best value to select a soft lens in the fitting principle. Some instruments and eye care practitioners (ECPs) in clinical practice use the horizontal OC-SAG only in the soft lens fitting process (as it is more difficult to measure vertical values). If only the horizontal OC-SAG is used – how much deviation is there from the average 360-value and how much difference is there compared to the vertical or other meridians?). This unknown factor may be one of the key pieces of the puzzle in understanding soft lens behavior on eye, and the potential of fitting soft lenses based on sagittal height in clinical practice.

Purpose

To analyze the differences of ocular sagittal height values in different meridians and in 360 degrees with a profilometer based ocular surface topographer, and to compared this to historical data with optical coherence tomography (OCT) based data measuring the ocular surface over the same chord diameters.

Methods

- ✓ OC-SAG of 50 healthy right eyes obtained with profilometry (ESP, Eye Surface Profiler, Eaglet Eye, The Netherlands).
- ✓ Values obtained for 15 mm and 12.8 mm chords in 360-degrees around the clock in 1-degree steps.
- ✓ Absolute differences between the horizontal (H), vertical (V), mean 360° and max/min values were obtained *(Figure 1)* and compared to a historical database with manual measurements with optical coherence tomography (Zeiss Visante AS-OCT) in another group of 39 patients.
- ✓ A three-dimensional model of mean OC-SAG values in the 360 degrees was also built and compared with the two methods (ESP and AS-OCT)

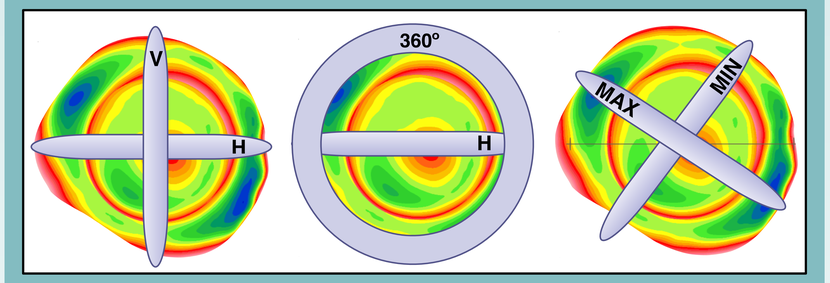


Figure 1

Results

- ✓ H vs V absolute differences in OC-SAG at a 15 mm chord:
  - With the current automated profilometry method: 103±92 μm (range 0-430 μm)
  - The historical manual method based on AS-OCT: 109±79 μm (range 0-255 μm)
- ✓ H-OC-SAG vs mean 360° OC-SAG absolute differences at 15 mm chord:
  - Profilometry: 58±52μm (range 0-260 μm)
  - AS-OCT: 79±49 μm (range 8-190 μm)
- ✓ Mean maximum difference between any two meridians:
  - Profilometry: 171±90 μm (range 40-450 μm) using the profilometer
  - AS-OCT:227±74 μm (range 90-390 μm)
- ✓ The mean profilometry values found where on average 106 μm lower than the OCT values. *(Table 1)*.

	n	Mean OC-SAG horizontal meridian (H)	Mean OC-SAG vertical meridian (V)	Mean OC-SAG 360°	H-V difference	H-V absolute difference	H-360° difference	H-360° absolute difference	Max difference in the 360°
OCT	39	3740±214 (3195-4240)	3745±199 (3290-4175)	3743±202 (3293-4221)	-5±134 (-235-255)	109±79 (0-255)	-34±87 (-190-127)	79±49 (8-190)	227±74 (90-390)
ESP	50	3653±158 (3330-3990)	3623±151 (3240-4030)	3637±135 (3280-3980)	30±136 (-240-430)	103±92 (0-430)	16±77 (-170-260)	58±52 (0-260)	171±90 (40-450)

Table 1 (unit μm)

- ✓ Three-dimensional models *(Figures 2 and 3)*:
  - Common pattern with a less elevated nasal area and deeper OC-SAG values at the temporal side.
  - Differences between quadrants were all more marked at the 15 mm chord diameter curves both methods.
  - The SD of both curves obtained with the profilometry (12.8 and 15 mm chords) showed a higher variability at the inferior -nasal area.

Figure 2: OC-SAG in 360° with the ESP

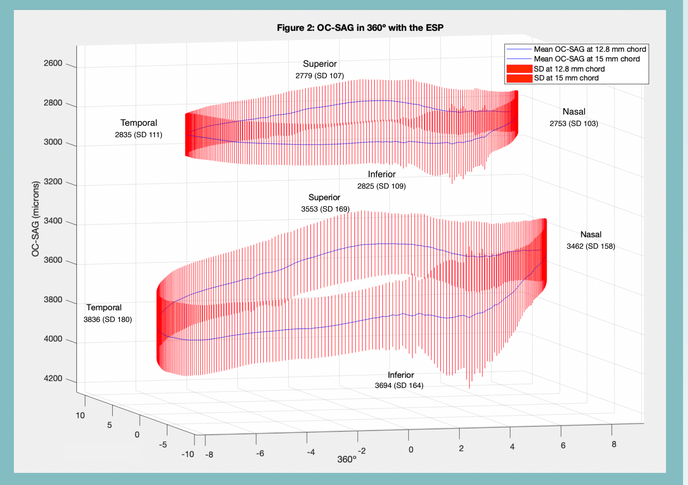
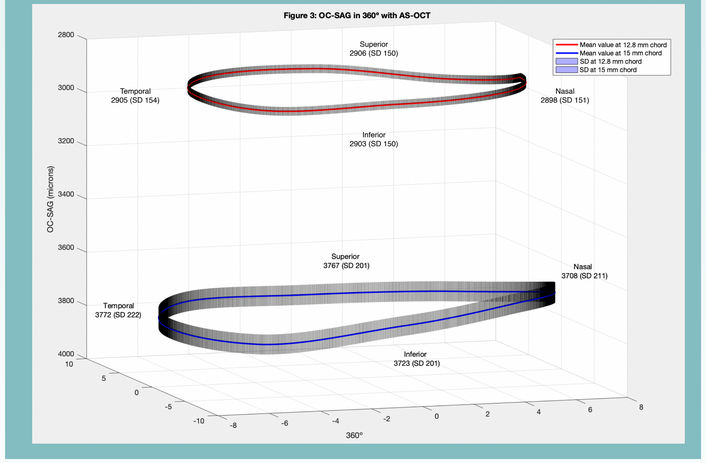


Figure 3: OC-SAG in 360° with AS-OCT



Discussion & Conclusions

- ✓ When looking at the anterior ocular surface in a 360-fashion – this study found that there are marked differences in OC-SAG values in different meridians. If only the horizontal OC-SAG value is used, this measurement typically differs by values less than ~100 μm compared to vertical or to average values. Further research is needed to determine whether this finding (less than ~100 μm difference) is clinically relevant in practice.
- ✓ Others[4-6] found mean 360 degrees OC-SAG values with profilometry in the ~3600 μm range, while Ritzmann, Sorbara and Hall obtained values with AS-OCT in the ~3700 microns.[7-9] This ~100 μm difference was also consistent in this study. Despite the difference in the mean 360 degrees OC-SAG values, the variation between meridians with both methods was very similar (~100 μm). It is unclear at this point where this difference stems from. Interestingly though, the differences in different meridians between the two instruments showed a high degree of similarities.
- ✓ The rotationally asymmetric nature of the sclera has an impact on the OC-SAG of the eye. These models obtained with two different methods in two different groups of healthy patients confirm a common pattern of OC-SAG values in 360 degrees, which can be defined by a hyperbolic paraboloid. This may be a better and more aplicable method than using single meridians.
- ✓ In conclusion: different meridians show different OC-SAG values, which may affect soft lens behavior on-eye. By measuring the H-OC-SAG only, the differences are not substantial, and may potentially prove to be clinically less significant, but this needs further investigation.

References

1. Michaud L, Lipson M, Kramer E, et al. The official guide to scleral lens terminology. Cont Lens Anterior Eye 2020; 43: 529–534.
2. Van der Worp E, Wolffsohn JS, Jones L. When was the last time you fitted a soft lens? Cont Lens Anterior Eye 2020; 43: 415–417.
3. Van der Worp E. The Science and Skill of Fitting a Soft Lens. Contact Lens Spectrum 2017; 32: 52–56.
4. Michaud L, Tremblay C, Grégoire S Relationship between ocular sagittal height and soft contact lens sagittal depth to improve fitting and comfort. Poster at GSLS 2018.
5. Rojas-Viñuela J, Piñero DP, Burgos-Martínez M. Comparing sagittal heights calculated using corneal parameters and those measured with profilometry. Cont Lens Anterior Eye 2023;46(2).
6. Van der Worp E. Reaching for the stars. Global Contact 2017;70(2):30-2.
7. Ritzmann M, Caroline PJ, Börret R, et al. An analysis of anterior scleral shape and its role in the design and fitting of scleral contact lenses. Cont Lens Anterior Eye 2018; 41: 205–213.
8. Sorbara L, Maram J, Fonn D, Woods C, Simpson T. Metrics of the normal cornea: anterior segment imaging with the Visante OCT. Clin Exp Optom 2010;93:150-6
9. Hall LA, Hunt C, Young G, Wolffsohn J. Factors affecting corneoscleral topography. Invest Ophthalmol Vis Sci 2013;54:3691-701.

[1] GOO, MSc, FAAO; University of Alicante, Centro de Lentes de contacto
[2] BOptom, PhD, FAAO; Eye-Contact-Lens Research and Eduction, Amsterdam
[3] PhD; University of Alicante

Email contact: soyjavirojas@hotmail.com

Disclosures: Javier Rojas, consultant of Eaglet Eye

Acknowledgement: Reinier Stortelder