Not Just SAG, a Theoretical Model to Compare the SAG of Soft Lenses

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Introduction

Over the last decade the soft lens market has learned that the dropout rate is not improving. The existing method of fitting soft lenses, based on the keratometry values of the eye and base curve (BC) of the lens does not work[1]. It has been suggested that a better method is based on the sagittal height of anterior segment and the sagittal depth (SAG) of a soft contact lens (CL)[2]. Therefore different studies have been looking into the SAG of the soft lens[3,4]. SAG is always calculated over a certain chord length, generally the full diameter of the lens. Although the lens diameters of one-size-fits-all lenses does not differ much (13.8 to 14.3mm), this may induce some variation in the measured SAG and slightly more if diameters are compared at on eye temperature (13 to 14mm)[5]. Considering the effect of different diameters on SAG results[6] and the effect of eye temperature on labelled diameters of contact lens in different materials[5] the direct comparation of SAG from different lenses it is not effective. In this poster a calculation theoretical method is introduced to correct the SAG for the lens diameters which may vary based on design and shrinkage due to eye temperature. An easy-to-use calculation method is introduced to correct the SAG for the various lens diameters which may vary based on design.

Method

To confirm the proposed model with the real shape of the lens the lens SAG of different spherical daily disposable and reusable soft contact lenses has been measured at eye temperature (34°) using an OCT based instrument (Optimec IS 830), see *Figure 1*. The parameters of the lenses listed in *Table 1* were obtained using a customized Optimec Chiltern modified to obtain measurements at eye temperature. The authors suggest to recalculate the lenses to a 14mm chord length and thus reducing the influence of different diameters, chord lengths. The suggested name by the authors is SAG equivalent (SAGe).

Proposed formulae

For every lens a Base Curve Equivalent (BCE) is calculated. BCE is proposed by G. Montani[2]. Comparing and fitting based on BCE is harder to understand while it does not have a linear relationship with SAG as shown in *Image 2*.

$$BCE = \frac{(lens\ diameter^2 + 4 * SAG@lens\ diameter^2)}{(8 * SAG@lens\ diameter)}$$

$$SAGe = BCE - \sqrt{BCE^2 - (\frac{chosen\ diameter}{2})^2}$$

In our calculation we set the chosen diameter at 14mm. The used formulae are standard for calculating curvatures and sagittal heights.

Highlights

- SAG can only be meaningfully compared over one and the same chord length.
- SAGe (SAG equivalent) may offer a better solution to compare the back surface SAG with each other.

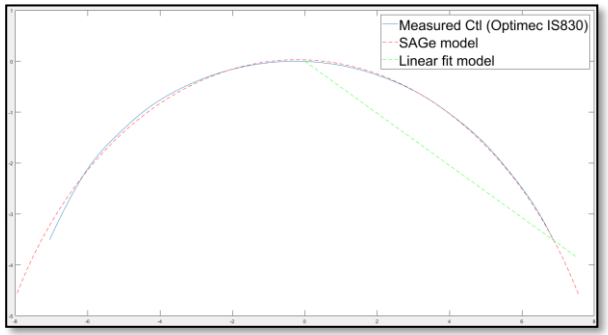

Figure 1: Comparison of a measured back surface of a soft lens with the proposed model. A linear fit is shown as well to compare the fit errors with the proposed model versus linear fitting.

Lens name	Given BCR	Diameter (@34° Celsius)	SAG	BCE	SAGe (@14mm)
Acuvue Moist	8.5	13.8	3.63	8.38	**3.773**
Oasys	8.4	13.9	3.61	8.50	**3.682**
Clarity	8.4	13.8	3.47	8.60	**3.607**
Avaira	8.5	13.9	3.52	8.62	**3.589**
Biotrue oneday	8.6	13.7	3.38	8.63	**3.582**
Purevision 2	8.6	13.9	3.47	8.70	**3.537**
Air optix plus hydraglyde	8.6	14.0	3.52	8.72	**3.520**
Ultra	8.6	14.1	3.58	8.73	**3.512**
Dailies total 1	8.5	14.1	3.58	8.73	**3.512**
Oasys 1day	8.5	14.2	3.65	8.73	**3.510**
Biofinity	8.6	13.9	3.43	8.76	**3.496**
Air optix aqua	8.6	14.1	3.55	8.78	**3.483**
Acuvue Moist	9	13.8	3.31	8.85	**3.437**
TruEye	8.5	14.2	3.54	8.89	**3.410**
Dailies aqua comfort plus	8.7	13.7	3.20	8.93	**3.384**
Oasys	8.8	13.9	3.31	8.95	**3.372**
Clarity	8.8	13.8	3.24	8.97	**3.363**
Oasys 1day	9	14.2	3.34	9.22	**3.217**
TruEye	9	14.2	3.22	9.44	**3.108**

Table 1: CL parameters measured with a customized Optimec Chiltern and calculated SAGe in descending order. In blue are highlighted all the CLs available in one BC. The SAGe difference for these CLs is only 205 µm.

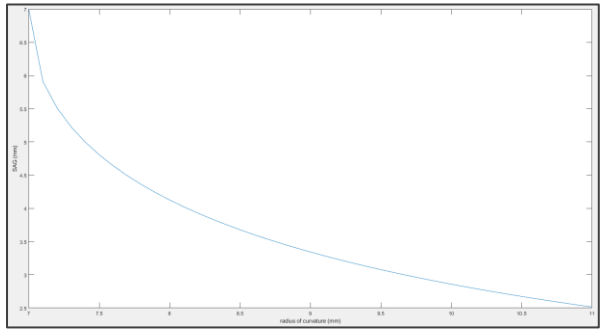

Figure 2: Showing the relation between radius of curvature and SAG. The conversion from radius of curvature to SAG makes it easier to compare lenses with each other.

Results

The model provided SAG values comparable to the measured SAG values at the 14mm chord length showing a difference below 50 microns. A difference of 205 microns was the maximum difference found in the SAGe of several commercially available frequent replacement soft lenses offered in one BC. Without correcting for the lens diameter, the maximum SAG differences are 447 microns for the same lenses (those lenses are shown in blue in Table 1). Another observation is the step size for those soft lenses offered in two BCs. Four of the five "lens pairs" show a step size very close to 300 microns and one outlier close to 250 microns.

Conclusion

In the current literature the SAG of several soft lenses is compared with each other. These studies show differences between the lenses offering one BC around 500 microns. Comparing this with the proposed SAGe the maximum difference is only 205 microns. Which may indicate that the variation in SAG design is minimal. Therefore, the authors believe that those lenses offered in just one BC are designed with the same average eye in mind. Clinically this means that changing the lens design to another may not result in tighter or looser fit. SAGe could be a useful parameter to assess and compare soft lenses designs.

References

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