EVALUATION OF THE EFFECT OF THE SAGITTAL HEIGHT OF SOFT CONTACT LENSES ON CORNEAL TOPOGRAPHY AFTER 4H AND 8H OF WEAR

Langis Michaud OD, M.Sc. FAAO (Dipl) FSLS FBCLA FEAOO; Amanda Gerbasi OD, Olivia Caldreri OD

École d'optométrie
Université de Montréal

Introduction

Lens fitting can influence the patient's comfort, the ocular physiology, by penalizing or enhancing tear exchange and the flush of toxins and debris which accumulates under its surface during lens wear, or the entrapment of chemicals and biocides, released in the first hours after lens soaking overnight in chemical solutions.

Lens fitting can also induce mechanical stress to the cornea, with unknown long-term effects on the immune system answer. This stress can become visible through corneal topography. Corneal topography is a useful technique to evaluate the quality of soft lens fit on the ocular surface. There seems to be a consistent correlation between corneal topography and soft contact lens fit regarding centration and corneal sagittal height. Changes occur in silicone hydrogel soft lens wear regardless of lens power, replacement frequency, lens manufacturer and design. Corneal deformations are often a result of suboptimal (inadequate) soft lens fitting.

More specifically, it has been shown that soft contact lens wear affects the normal physiological structure of the cornea, especially the corneal thickness. In fact, it was observed that the corneal epithelial thickness decreases with long-term soft contact lens wear. The corneal epithelium serves as the first protective barrier of the cornea and presents significant regeneration and repair capacities. It has a role in preventing microorganism invasion and it is an essential medium for optical transduction and refraction. Again here, .

OBJECTIVE

To evaluate the changes made to corneal topography following four hours and eight hours of wear of silicone hydrogel contact lenses with two different base curve radius.

Materials

On two non-consecutive days, subjects will be asked to wear the same lotrafilcon A soft contact lenses with two different base curves (8.4mm and 8.6mm) for a period of eight hours, bilaterally in randomized order.

DAY 1 : OD wears 8.4 mm BC for 8h00 in a row- topo made
OS wears 8.6 mm Bc for 4h00 – topo made – resume lens wear

DAY 2: OD wears 8.4 for 4h00 – topo made – resume lens wear
OS wears 8.6 mm BC for 8h00 in a row- topo made

Corneal topography and corneal epithelial thickness will be compared with baseline measures at 4 hours and 8 hours post-insertion.
The instruments used in this study are the slit lamp, for cornea inspection and lens centration and movement, the Medmont corneal topographer, the Eaglet-Eye ESP eye profiler, and the Optovue anterior segment OCT, the last three ones being used to map the ocular surface.

RESULTS

The mean horizontal ocular sagittal measured with the Eaglett ESP for the right eye was 3562 µm ± 238.5µm and 3562± 228.6µm for the left eye with a minimum of 3097µm and a maximum of 3980 µm, measured for 15 mm chord. The mean ocular sagittal extrapolated from the Medmont E300 for the right eye was 3665±224µm and 3691±163.9µm for the left eye with a minimum of 3215µm and a maximum of 3987µm for a 14 mm chord. (table 1)

This supports the fact that normal eyes were used in this study since the total sagittal height for a normal eye is approximately 3700 microns with a standard deviation of 200 microns for a 15mm chord.

Results

There was a statistically significant difference between the value measured by the Eaglett ESP and the one extrapolated from the Medmont E300 for the left eye (p=0.029) with the value of the Medmont being greater than the value measured with the Eaglett ESP. There was no statistically significant difference for the right eye (p=0.170). (table 2)

Table 1. Horizontal ocular sagittal height and simK of right and left eye for a chord of 15 mm

	Mean Horizontal sag (µm) R	Mean Horizontal sag (µm) L	Mean SimKs R	Mean SimKfR	Mean SimKs L	Mean SimKf L
Mean	3562	3562	43.14	41.38	43.35	41.24
Std. Deviation	238.5	228.6	1.643	1.674	1.838	1.581
Minimum	3097	3103	39.13	37.13	38.93	37.33
Maximum	3980	3933	45.60	43.73	46.10	43.47

Table 2. Comparison of horizontal ocular sagittal height measured with the Eaglet ESP (chord of 15mm) with the extrapolated value from the Medmont E300 (chord of 14 mm)

	EAGLETT OD	EAGLETT OS	MEDMONT OD	MEDMONT OS
Mean	3562	3562	3665	3691
Std. Deviation	238.5	228.6	224.0	163.9
Minimum	3097	3103	3215	3401
Maximum	3980	3933	3987	3964

Table 3. Paired Samples T-Test comparing Eaglet ESP and Medmont E300 ocular sagittal height values

	t	df	p
EAGLETT OD - MEDMONT OD	-1.446	14	0.170
EAGLETT OS - MEDMONT OS	-2.433	14	0.029

Note. Student's t-test.

Table 4. Mean SRI values at t=0 (BL), t=4 and t=8 for the 8.6 (A) and 8.4 (B) lenses

	BL	SRI A4	DIFF	BL_5	SRI A8	DIFF_7	BL_8	SRIB4	DIFF_10	BL_11	S
Mean	0.203	0.246	0.043	0.237	0.259	0.022	0.255	0.218	-0.037	0.237	
Std. Deviation	0.092	0.094	0.124	0.084	0.134	0.169	0.146	0.107	0.132	0.071	
Min.	0.040	0.130	-0.210	0.100	0.090	-0.260	0.080	0.120	-0.370	0.130	
Max	0.380	0.480	0.290	0.350	0.500	0.380	0.540	0.480	0.220	0.350	

Table 5. Paired Samples T-Test comparing mean baseline SRI and mean SRI after 4 & 8hours of wear

	t	df	p
BL - SRI A4	-1.33	14	0.204
BL_5 - SRI A8	-0.504	14	0.622
BL_8 - SRIB4	1.077	14	0.300
BL_11 - SRIB8	1.306	14	0.213

Note. Student's t-test.

CORNEAL EPITHELIAL THICKNESS

For the lens with the steeper sagittal height (CB 8.4mm), the corneal epithelial thickness (CT) at time 0 was 53,3±3,4 µm (N), 52,4±3,7µm (T) 52,3±3,2 (S) et 54,4 ±3,8µm (I) respectively. There were no statistically significant changes in these values after four or eight hours of wear. For the lens with the flatter sagittal height (CB 8.6mm) at time 0, the CT was 52.8±3.6µm (N), 51,9±4,1µm (T), 52,3±3.8µm (S) and 53.7±4,1µm respectively. Again, there were no statistically significant changes in these values after four or eight hours of wear. (table 3)

SRI

The mean baseline SRI was 0.20±0.09. The mean SRI after four hours of wear with the 8.6 lens was 0.25±0.09. (table 4) The mean baseline SRI was 0.24±0.08 and it was 0.26±0.13 after eight hours of wear with this same lens. The mean baseline SRI was 0.25±0.15 and it was 0.22±0.11 after four hours of wear with the 8.4 lens. The mean baseline SRI 0.24±0.07 and it was 0.20±0.08 after eight hours of wear with this same lens. There were no statistically significant changes from baseline SRI values for both lenses after four and eight hours of wear (8.6: p=0.204, p=0.622 and 8.4: p=0.3, p=0.213). (table 5)

SAI (tables 6 and 7)

The mean baseline SAI was 0.49±0.16 and 0.53±0.21 after four hours of wear with the 8.6 lens. The mean baseline SAI 0.53±0.24 and 0.49±0.17 after eight hours of wear with this same lens. The mean baseline SAI was 0.49±0.15 and 0.51±0.29 after four hours of wear with the 8.4 lens. The mean baseline SAI 0.53±0.26 and 0.50±0.22 after eight hours of wear with this same lens. There were no statistically significant changes from baseline SAI values for both lenses after four and eight hours of wear (8.6: p=0.316, p=0.461 and 8.4: p=0.755, p=0.492).

Table 6. Mean SAI values at t=0 (BL), t=4 and t=8 for the 8.6 (A) and 8.4 (B) lenses

	BL	SAI A4	DIFF	BL_5	SAI A8	DIFF_7	BL_8	SAIB4	DIFF_10	BL_
Valid	15	15	15	15	15	15	15	15	15	
Missing	1	1	1	1	1	1	1	1	1	
Mean	0.489	0.529	0.041	0.525	0.487	-0.039	0.489	0.507	0.019	0.5
Std. Deviation	0.162	0.210	0.152	0.240	0.171	0.198	0.152	0.292	0.227	0.2
Min.	0.300	0.260	-0.150	0.280	0.310	-0.520	0.300	0.170	-0.380	0.2
Max.	0.800	1.050	0.360	1.080	0.940	0.400	0.810	1.110	0.530	1.0

SIMK VARIATION (Medmont) after 4 and 8 hours of wear with 8.4 and 8.6 lens

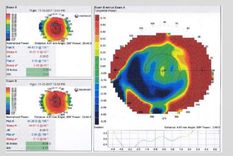
The average variation in corneal curvature after four hours of wear of the lens (from measurements at t=0) with the steep sagittal (CB 8.4mm) was 0.943±2.93D at 4mm nasal and -0.144±2.53D at 4mm temporal with a range between -3.62D and 6.92D. The average variation after eight hours of wear of the same lens was -0.243±2.34D at 4mm nasal and 0.483±1.15D at 4 mm temporal with a range between -6.59D and 2.29D. (Table 8)

The average variation in corneal curvature after four hours of wear of the lens (from measurements at t=0) with the flat sagittal (CB 8.6mm) was 0.03±2.43D at 4mm nasal and -0.052±1.13D at 4mm temporal with a range between -7.08D and 2.47D. The average variation after eight hours of wear of the same lens was 1.052±3.50D at 4mm nasal and -0.471±2.01D at 4 mm temporal with a range between -7.25D and 12.88D.

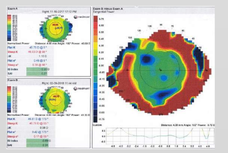
Table 7. Paired Samples T-Test comparing mean baseline SAI and mean SAI after 4 & 8hours of wear

	t	df	p
BL - SAI A4	-1.039	14	0.316
BL_5 - SAI A8	0.758	14	0.461
BL_8 - SAIB4	-0.318	14	0.755
BL_11 - SAIB8	0.706	14	0.492

Note. Student's t-test.



Differential map after 4h00 (8.4 BC)



Differential map after 8h00 (8.6 BC)

LENS PREFERENCE

As for lens preference, 83% of the subjects preferred wearing the lens with the steeper sagittal height (CB 8.4 mm) as it was more comfortable.

Discusion

Although we did measure slight variations in the corneal topographic parameters as well as in corneal epithelial thickness, these changes were not statistically significant. We can conclude that the use of a tight fitting (high sagittal) contact lens does not generate a change in corneal epithelial thickness after a full eight hours of wear. This is in accordance to the literature This was the same for the higher sagittal lens (8.4) as well as for the lower sagittal lens (8.6).

Similarly, there was no statistically significant compression of the cornea in any of the four quadrants by using a tight fitting soft contact lens. The cornea's overall topography did not get altered by the daily wear of soft contact lenses, with either the 8.4 or 8.6 lens. This means mechanical stress induced by soft contact lenses is minimal when lenses are properly fitted to the patient's eye.

The sagittal depth of the flat lens (spherical Air Optix Night & Day, CB 8.6) is approximately 3679µm and the mean ocular horizontal sagittal height in the present study was 3562 µm ± 238.5µm. Since this lens was uncomfortable for most of the subjects, this means that sagittal depth of the lens should exceed by more than 110 um the ocular surface height to reach a comfortable wear.

Conclusion

High modulus Silicone Hydrogel lenses exceeding ocular sagittal height by more than 110 um are providing more comfort without inducing more mechanical stress on the cornea .