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Noninvasive In Vivo Assessment of Soft Contact Lens Type on Tear Film Surface Quality

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Purpose. To evaluate the effect of soft contact lens type on the in vivo tear film surface quality (TFSQ) on daily disposable lenses and to establish whether two recently developed techniques for noninvasive measurement of TFSQ can distinguish between different contact lens types.

Methods. Thirteen subjects wearing four different types of daily soft contact lenses participated in the study. Dynamic area high-speed videokeratoscopy (HSV) and lateral shearing interferometry (LSI) were used to quantitatively assess TFSQ in natural blinking conditions in the morning soon after lens insertion and in the afternoon following 8 hours of lens wear.

Results. All considered contact lenses caused a significant reduction in TFSQ compared with bare eye measures. Significant differences ($P < 0.05$) in the average TFSQ were also observed between all contact lens materials in LSI measurements and in the majority of dynamic area HSV measurements. The potential relationship between the contact lens parameters and the observed decline in the prelens TFSQ was explored.

Conclusions. Noninvasive techniques of tear film surface assessment have the potential to discriminate contact lens type/material on eye. LSI was found to more effectively perform this discrimination than the dynamic area HSV technique. (*Invest Ophthalmol Vis Sci.* 2012;53:525–531) DOI:10.1167/iovs.11-8257

It is well known that the presence of a contact lens in the eye disrupts the precorneal tear film by dividing it into prelens and postlens tear film layers.[1–3] In such conditions, the effective evaporation barrier is severely compromised because the otherwise confluent lipid layer presents itself in an altered form.[4,5] Changes in the quality of the tear film with contact lens wear are evidenced by decreased tear film breakup time (TBUT) and increased evaporation and thinning rates.[6–8] Contact lens–induced tear film changes are significant clinically because a large proportion of contact lens wearers report dry eye symptoms,[9] and symptoms of dryness have been found to be a primary reason for contact lens intolerance.[10] The exact cause of contact lens–related dryness is not known; however, it is likely to be multifactorial and to involve complex interactions between patient-related tear film factors, contact lens-related factors, and environmental factors.

Given the potential importance of contact lens–related factors in the development of dry eye symptoms,[11–14] numerous studies have been carried out to investigate the influence of different contact lens types (e.g., lens materials, manufacturing methods, and surface characteristics) on the quality of the tear film. Although studies conclude that all soft contact lens materials do adversely affect tear film physiology,[15] most studies examining the influence of different contact lens types on clinical measures of tear film quality (e.g., noninvasive TBUT) in vivo have failed to detect significant differences between lens types.[16–21] For example, Thai et al.[19] investigated the effect of five contact lens materials, including hydrogel and silicone hydrogel lenses, and found no significant differences in tear evaporation rate and tear thinning time among the five considered materials. Similarly, Maldonado-Codina and Efron[20] found limited significant differences between a range of soft lenses of different materials and methods of manufacture in terms of their effects on tear film stability and structure.

In contrast to these studies of the in vivo effects of contact lenses on the tear film, in vitro studies examining contact lens surface properties that are likely to be related to contact lens–tear film interactions, such as contact lens surface wettability[22–25] and lens surface roughness,[26,27] have typically noted (sometimes substantial) significant differences among different lens types in terms of these characteristics. The reason in vivo studies have not found differences associated with different contact lens types, despite evidence of significant differences in the surface wetting characteristics of different lenses, is unclear. It is possible that individual patient-related tear film factors in these studies had a greater effect on in vivo tear film measures than differences in contact lens surface wettability between lens types.[16] Alternatively, the relatively large intersubject variability associated with standard in vivo clinical tear film measures may be the reason that differences associated with contact lens types have not been detected.[21] Although environmental factors could potentially bias in vivo studies of tear film quality,[6] some studies have shown no effect of environment in terms of lens dehydration.[28]

In this study we used two recently developed noninvasive techniques[29–33] that have been shown to exhibit high precision[32] for tear film measures and to discriminate dry from normal eyes[33] to quantitatively investigate the quality of the prelens tear film with different contact lens types. We aimed to evaluate the effect of a range of different daily disposable soft contact lens types on tear film surface quality and to establish whether the noninvasive measurement techniques used can distinguish between the different contact lens types.

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Subjects, Materials, and Methods

Subjects

Thirteen Caucasian subjects (3 women, 10 men; age range, 25–47 years; mean ± SD age, 32 ± 7 years) were recruited for this study. The study was approved by the university human research ethics committee, and all subjects gave informed consent before participation and were treated in accordance with the Declaration of Helsinki. To ensure consistency between subjects in terms of patient-related tear film factors and environmental factors, all subjects were required to have a clinically normal tear film and all were working in the same air-conditioned office performing similar visual tasks (predominantly computer work) for the duration of the study. No subject had a significant history of ocular allergies, injuries, infection or surgery, and none took medications known to influence the ocular condition.

All subjects underwent a standard clinical assessment of dry eye signs and symptoms, identical with that performed in a dry eye study reported earlier.[33] The assessment included clinical history, McMonnies questionnaire,[34] slit lamp biomicroscopy examination, phenol red thread test of tear volume,[35] fluorescein TBUT (FTBUT), and assessment and grading of ocular surface staining with fluorescein and lissamine green dyes using the National Eye Institute (NEI) grading scales.[36] All clinical measurements were performed by one experienced clinician (SAR), who was masked to the measurements performed with the two considered noninvasive methods of tear film surface assessment. Based on this screening, marginal dry eye was diagnosed in one subject who exhibited a reduced FTBUT (mean FTBUT, 7.2 seconds) and signs of corneal surface staining (NEI score, 3). This subject was excluded from further analysis. The remaining 12 subjects were assessed as having normal tear film and ocular surface. One subject in the group was a regular wearer of daily soft contact lenses and was asked to stop wearing lenses for 1 week before the start of the experiment. Additionally, during lens wear, subjects were asked to indicate their subjective feeling of lens comfort on a discrete scale from 1 to 10, with 1 denoting the best comfort and 10 denoting the worst.

Noninvasive Methods: Measurement Protocol

The assessment of tear film surface quality was performed with two noninvasive methods: dynamic area high-speed videokeratoscopy (HSV) and lateral shearing interferometry (LSI). Instruments for both methods were located in the same room in which the environmental conditions were monitored. The average temperature in the measurement room was (24.5° ± 1.4°C), and the average humidity was (49.4% ± 9.9%). As noted in previous studies,[32,33] small changes such as those in the room environmental conditions should not significantly affect the quality of the tear film surface.

TFSQ was measured for all subjects while they wore four different types of daily disposable contact lenses, each of the four pairs on a different day. To minimize potential bias, the names of the lenses were masked (labeled A, B, C, D), and the order of lens wear was randomized for each of the subjects. Generic descriptions of the material properties of the tested lenses are presented in Table 1.

The lenses were worn in both eyes, but only the right eyes of the subjects were measured. All measurements were taken in the morning between 8:00 AM and 10:00 AM, 30 minutes after lens insertion [37] and again in the afternoon between 4:00 PM and 6:00 PM, after 8 hours of contact lens wear. A break of at least 1 day was provided between the contact lens–wearing days. Additionally, each subject's baseline (precorneal) tear film surface quality was measured on a separate day in the morning and afternoon, before the subject began wearing contact lenses.

The order of instruments used was also randomized. All lenses were inserted by the same experienced clinician directly from a blister pack/solution into the eye. No rinse with a multipurpose solution (MPS) was applied because of the potential influence or interaction of MPS with the lens material. The lens power was standardized for all lenses and subjects at −0.50 D, and subjects could wear their own spectacles over the top if needed. The fitting characteristics of each lens were assessed using standard clinical techniques and were determined to be acceptable for all lenses.

Tear film surface quality was assessed in natural blinking conditions. Subjects were asked to blink naturally without deliberately keeping their eyes open during a 40-second measurement. Subjects knew that the tear film quality was being examined but were not aware that their blinking pattern was also being considered. A break of at least 1 minute was allowed for the subject before the measurement with the second instrument was taken.

Instrumentation

The two considered methods of noninvasive assessment of tear film surface quality have been comprehensively described in our earlier works.[30,38–41] In short, the dynamic area HSV method[38] is based on the projection of a Placido disc pattern onto the corneal outer layer, the tear film, and capturing the reflection with a video camera. Over time, certain features of the reflected image, in which interference from the eyelashes is dynamically excluded in each frame, provided a time-varying tear film surface quality indicator.

In the LSI apparatus,[39] the HeNe laser–generated wavefront reflects from the tear film surface and creates, through a shearing processes, an interferogram. The shape of interference fringes corresponds to the temporal stage of precorneal/prelens tear film surface. The method of numerical analysis is based on the fast Fourier transform combined with image processing techniques[42] that result in a time-varying tear film surface quality indicator robust to changes caused by natural eye movements. Both techniques capture images at a constant rate of 25 frames per second.

Blinking Patterns

Blinks were automatically extracted from each of the 40-second long recording. In the LSI technique,[42] a blink corresponds to a set of frames in which the interferogram pattern is no longer present, and this leads to a substantial decrease in the average image intensity value. In the HSV technique,[38] on the other hand, a blink corresponds to frames with no Placido disc pattern and a substantial increase in the average image intensity. To extract those frames, an algorithm was written in which the average image intensity was calculated for each frame in the sequence and then empirically thresholded.

The interblink interval (IBI) data were tested for normality (Jarque-Bera test) and were rejected ($P > 0.05$). Subsequently, the median and

Table 1. Generic Description of the Material Properties of Tested Lenses

Lens	FDA Group	DIA/BOZR/Thickness at −3.00 D	H_2O (%)	Charge	Dk	Type of Hydrogel	Wetting Agent
A	II	14.0/8.7/0.10 mm	69	Nonionic	26	Polyvinylalcohol	Hydroxypropyl-methylcellulose, polyethylene-glycol, polyvinylalcohol
B	IV	14.2/8.5/0.084 mm	58	Ionic	28	HEMA copolymer	Polyvinyl pyrrolidone
C	II	14.2/8.7/0.09 mm	60	Nonionic	33	HEMA copolymer	Phosphorylcholine
D	I	14.2/8.5/0.085 mm	46	Nonionic	100	Silicone hydrogel	Polyvinyl pyrrolidone

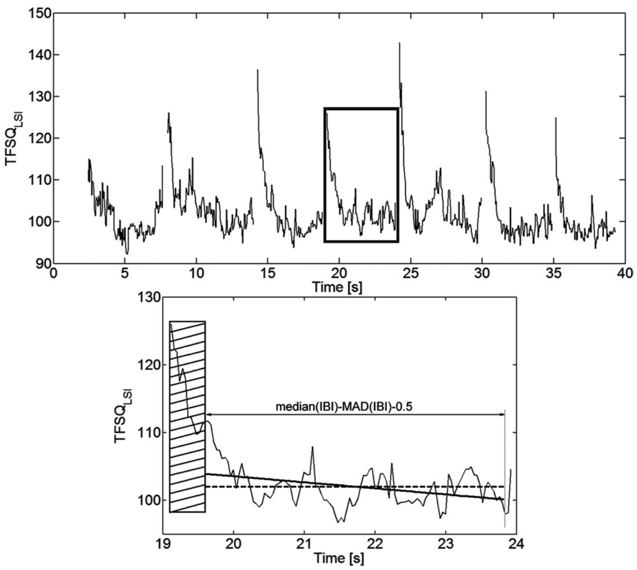

FIGURE 1. *Top*: example of the estimated TFSQ from a 40-second recording in natural blinking conditions using the LSI technique. Discontinuities in the plot indicate blinks. *Bottom*: extracted IBI (encompassed by a *box* in the *top* plot) in which the first 0.5 second is omitted (*dashed box*) and the $TFSQ_{Av}$ (*dashed line*) and the TFSQ slope (*thick solid line*) are indicated. A similar approach was used to analyze the data from the dynamic HSV technique.

the median absolute deviation (MAD) were considered for calculating the IBI for an individual subject (T_{ibi}). The group average T_{ibi} for precorneal (baseline) tear film was 3.66 ± 2.16 seconds (mean ± SD) in dynamic area HSV and 5.85 ± 2.86 seconds in LSI. For prelens tear film it was 2.61 ± 0.90 seconds and 4.04 ± 1.27 seconds, respectively. The subjects were blinking more frequently with the lens on eye; however, statistical testing by means of repeated-measures ANOVA revealed that across the precorneal and prelens tear film, there were statistically significant differences in the IBI in LSI ($P = 0.007$) measurements but not with the dynamic area HSV ($P = 0.064$). In contrast to our previous study,[32] the subjects were blinking less frequently in LSI than in dynamic area HSV, and the differences in the group average T_{ibi} were statistically significant ($P < 0.01$).

Statistical Analysis

Two parameters of interest were extracted from the time series from each technique, the average tear film surface quality ($TFSQ_{Av}$) and the interblink TFSQ slope (Fig. 1). The following procedure was used to obtain these parameters from each recorded sequence. For each subject, only the IBIs that were longer than their estimated median minus one MAD were considered. This was done separately for the precorneal and prelens measurements. In addition, the $TFSQ_{Av}$ was evaluated 0.5 second after blink to allow the tear film to build up. To assess the dynamic behavior of precorneal and prelens TFSQ, a linear function was fit to the data within the IBI (i.e., from the 0.5-second postblink to the median minus MAD of the IBI).

There were several reasons for such a computational approach. According to our previous study on precorneal tear film,[32] the tear film buildup time can last up to 1 second. However, it was evident from our current data that the tear film stabilizes more rapidly on contact lenses than on the cornea. We therefore assumed that 0.5 second was sufficient time for the tear film to spread (build up) on the contact lens after a blink, and this point was chosen as the starting point for the linear fit of the TFSQ series. During the 40-second video recording, some subjects at times performed rapid blinks that were too short for the tear film to build up and therefore did not provide adequate reliable data. Thus, these IBIs had to be excluded from the analysis. On the other hand, other exceptionally long IBIs were recorded. For these cases, the contact lens surface was drying at the end of the IBI, and, consequently, the TFSQ measure was giving much higher (in LSI) or much lower (in HSV) values at the end of the long IBI, which could also distort the results. Hence, we decided to select a standardized IBI for all the measurements to allow a fair comparison. Taking into account that IBI data are not normally distributed, we decided to use the median minus MAD parameter rather than the mean minus 1 SD to make our procedure more robust. Our aim was to analyze only typical IBI time for the particular subject. Then the group average slope was calculated for the precorneal and prelens TFSQ.

Statistical analyses included standard descriptive statistics, normality testing, correlation analysis, and repeated-measures ANOVA.

RESULTS

Average Tear Film Surface Quality

There were no statistically significant between-group differences in $TFSQ_{Av}$ for precorneal tear film in morning versus afternoon measurements taken by both instruments ($P > 0.3$). Morning and afternoon prelens tear film results were subtracted from the respective baseline measurements. The decline in the $TFSQ_{Av}$ from baseline, expressed in percentage, was determined for each subject. The group average results (with the corresponding standard errors) for each lens type for dynamic area HSV and LSI measurements are presented in Figures 2 and 3, respectively. Group results are shown for combined morning and afternoon measurements because no significant differences ($P > 0.05$) were observed between the two measurement times for both instruments. The SE measures were calculated based on the number of subjects.

Repeated-measures ANOVA (bootstrap adjusted) was used to investigate differences in TFSQ associated with contact lens type/material. Statistically significant differences ($P < 0.05$) were found between all types of lenses measured with the LSI technique. In dynamic area HSV measurements, there were significant differences ($P < 0.05$) between two pairs of lenses (i.e., between lenses C and D and between lenses A and D). The differences between lenses B and C and lenses B and D bordered on statistical significance ($P = 0.053$), and there was no statistically significant difference between lenses A and B and lenses A and C. Results of the statistical analyses are summarized in Table 2. Additionally, we conducted the Wilcoxon signed rank test on the between-lens data for the individual subjects, and the test confirmed the results of the repeated-measures ANOVA.

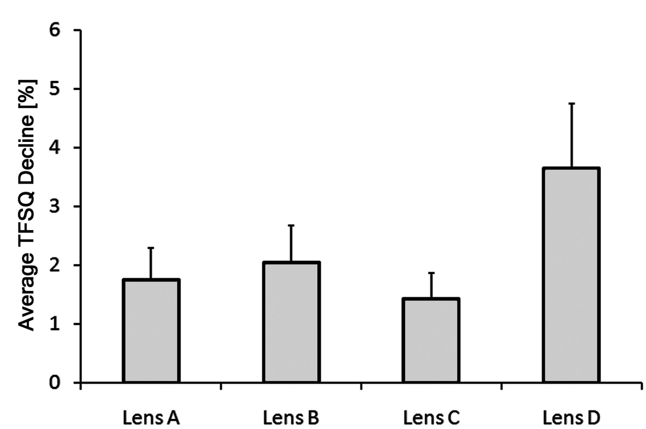

FIGURE 2. Decline in the average prelens TFSQ (%) with respect to that of the precorneal tear film as measured with the dynamic area HSV. Morning and afternoon measurements are combined. Error bars denote 1 SD. Table 1 describes the main parameters of the lenses considered.

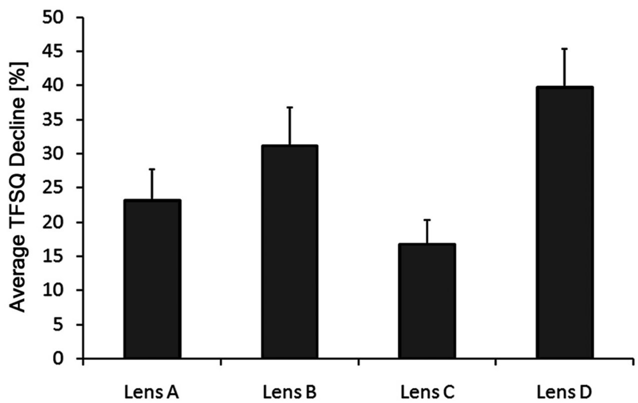

Figure 3. Decline in the average prelens TFSQ (%) with respect to that of the precorneal tear film, as measured with LSI. Morning and afternoon measurements are combined. Error bars denote 1 SD. Table 1 describes the main parameters of the lenses considered.

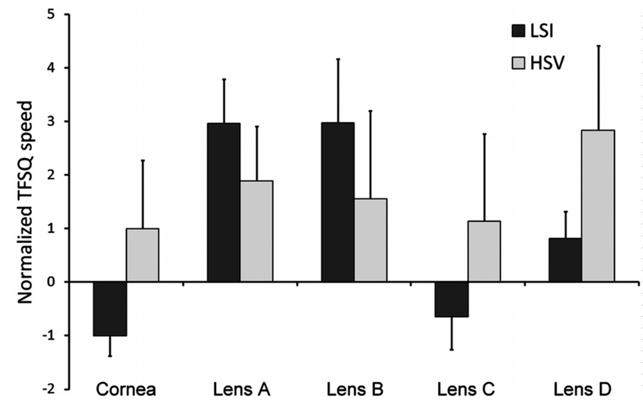

Figure 4. Normalized TFSQ slope measured by LSI (*dark gray*) and HSV (*light gray*). Error bars denote 1 SE. The sign of the slope indicates whether TFSQ was improving (*negative sign*) or declining (*positive sign*) within the considered period of the IBI. Table 1 describes the main parameters of the lenses considered.

To ascertain the relationship between the two methods of measurement, the average decline in $TFSQ_{Av}$ values for each of the subjects and each of the four lenses from the dynamic area HSV were contrasted against those of LSI. The correlation between the two techniques for each individual lens was weak (ranged, $r = 0.20$ [lens C] to $r = 0.33$ [lens B]). It substantially improved, however, when AM and PM data were averaged (range, $r = 0.33$ [lens C] to $r = 0.63$ [lens B]). The overall estimated correlation coefficient, $r = 0.46$, was found to be significant ($P = 0.0005$).

Kinetics of Tear Film Surface Quality

Figure 4 presents the group average TFSQ speed (slope), normalized with respect to that of the precorneal (baseline) TFSQ, for LSI (dark gray) and HSV (light gray). For the HSV method, the TFSQ time series was reversed to match that of the LSI method. The sign of the slope indicated whether the quality of the tear film surface was improving (negative sign) or declining (positive sign) within the considered period of the IBI. Repeated-measures ANOVA revealed statistically significant differences between all types of lenses ($P < 0.05$) except between lens A and lens B ($P = 0.46$) in LSI. For the HSV method, no statistically significant differences were found in the TFSQ slopes. There were also no significant differences in the TFSQ slopes between the morning measurements and those performed in the afternoon.

Subjective Comfort

Table 3 provides the average subjective comfort scores for the four different lenses in the morning and afternoon. Repeated-measures ANOVA was carried out to investigate the effects of time of day and lens type. Lens comfort scores in the morning were statistically significantly lower (better comfort) than in the afternoon ($P < 0.05$). However, across the different lens types, no statistically significant differences were observed ($P = 0.4$). Finally, no significant correlations were found between the decline of $TFSQ_{Av}$ with either technique and subjective scores.

Discussion

This study demonstrates that both LSI and HSV techniques of noninvasive tear film assessment were able to show significant differences in tear film surface quality associated with contact lens type. Both considered methods were found to provide comparable mean values of tear film surface quality across the different lens types. One should note that the measurements of precorneal (baseline) and prelens tear film with the two techniques were not performed simultaneously. A significantly moderate correlation between the two techniques was observed when the average of the morning and afternoon measurements was used. This suggests that some within-session variability in the prelens tear film surface quality influenced the results. However, the fact that the correlation was still only moderate suggests some additional variability associated with the two instruments.

Most previous studies examining clinical tear film measures with different contact lens types have typically not found significant differences between lens types,[15–21] despite the considered lenses often having different material properties and in vitro wetting characteristics. It should be noted that most tear film measurement techniques used in these previous studies have involved some subjective assessment or grading of the tear film and tests, such as noninvasive TBUT, that have been shown to have relatively high levels of variability both with and without contact lenses in situ.[43,44] The excellent repeatability[32] and objective nature of the noninvasive tear film

Table 2. Test Statistics (Bootstrap-Adjusted *P* Values, Repeated-Measures ANOVA) for the Dynamic Area HSV and LSI Measurements

	A		B		C	
Lens	**HSV**	**LSI**	**HSV**	**LSI**	**HSV**	**LSI**
B	0.358	**0.017**	X	X	X	X
C	0.298	**0.021**	0.053	**0.001**	X	X
D	**0.049**	**0.002**	0.053	**0.046**	**0.023**	**0.000**

Statistically significant differences ($P < 0.05$) are indicated in bold.

Table 3. Descriptive Statistics of the Subjective Lens Comfort Scores for the Four Lens Types

	Lens A		Lens B		Lens C		Lens D	
	AM	PM	AM	PM	AM	PM	AM	PM
Median	2.00	3.50	2.00	3.00	2.00	3.00	2.50	2.50
MAD	0.50	1.00	0.50	1.00	0.75	1.00	0.50	0.50

Lens comfort was rated on a discrete 10-point scale, with 1 indicating best comfort and 10 indicating worst comfort.

measurement techniques used in our present study might have contributed to the detection of significant differences associated with contact lens type. Furthermore, the relatively homogeneous nature of our tested population of subjects, in terms of bare eye tear film quality and environment in which the lenses were worn, might have helped to limit intersubject variability in tear film quality associated with patient and environmental factors and might have allowed the differences associated with lens type to be highlighted.

Previous research suggests that interactions between the lens surface and proteins[45] and lipids[46] in solution can improve in vitro lens wettability, which implies that some adsorption of tear film components by the lens surface could potentially improve prelens tear film surface quality over time. Given that all the lenses tested in our present study were the daily disposable type that are worn for only an 8-hour period and do not show any significant differences between morning and afternoon measures of tear film surface quality, it does not appear that interactions between the subjects' tear film components and the lens surface substantially influenced our results. However, because previous studies have demonstrated that changes in prelens tear film quality occur over time with longer periods of wear,[18,20] it is possible that a longer duration of lens wear could lead to different results than our current findings. The fact that the LSI and HSV techniques were sensitive to tear film differences associated with contact lens type with short-term wear suggests that these techniques will also be useful in future research to investigate the influence of longer periods of lens wear on tear film surface quality.

When examining the average TFSQ, all lenses exhibited a significant decline compared with bare eye conditions, which is consistent with a number of previous studies.[19,30] However, a number of significant differences between lens types in $TFSQ_{Av}$ were also found. The smallest decline in $TFSQ_{Av}$ compared with bare eye conditions was observed with lens C (followed by lenses A and B), and the greatest decline of tear film quality was recorded with lens D, the only silicone-hydrogel lens in the group. The between-lens differences in $TFSQ_{Av}$ were statistically significant for all lenses with the LSI technique and for most lenses with the HSV technique. With regard to the kinetics of the TFSQ (interblink TFSQ slope), it was noted that TFSQ was significantly more stable on lens C, providing values close to the bare eye condition for both instruments. Lens types A and B also exhibited similar kinetic behavior between instruments, showing steeper slope values than lens C. Only the slope values of lens D appeared to vary across the instruments; HSV provided a steeper slope value than the LSI method. A gentle slope of TFSQ on lens D in the LSI method indicated that TFSQ does not worsen much during the IBI.

It is likely that a complex interaction among a variety of factors associated with a particular contact lens will determine its particular in vivo influence on the tear film. Parameters such as the geometry of a contact lens, particularly its diameter[47] and thickness, and material properties such as water content, charge, type of hydrogel, and wetting agent could all potentially influence the tear film layer. Because of the likely complexity of the relationship between lens design and tear film, it is difficult to link a single lens design/material parameter with the TFSQ changes obtained in this study. However, it is interesting to note that the lens exhibiting the greatest decrease in $TFSQ_{Av}$ (lens D) was the only silicone hydrogel lens tested, which is consistent with previous in vitro study results of lens wettability that showed silicone hydrogel lens materials were more hydrophobic than conventional hydrogel materials.[24] The lens exhibiting the smallest decline in $TFSQ_{Av}$ (lens C) is a hydrogel lens incorporating phosphorylcholine into the material, a class of lens that has previously been found to exhibit less on-eye dehydration than other hydrogel lenses.[17]

Guillon[48] suggested that the design of the contact lens edge profile could influence the lipid layer because it may act as a barrier for correct lipid spreading. To provide insight into the potential influence of the lens edge on prelens TFSQ, we have cut thin radial slices from each of the four considered lenses and imaged the lens profiles using phase-contrast microscopy. Representative examples of lens edge profiles are shown in Figure 5. We observed that the lens that exhibited the smallest decline in prelens TFSQ (lens C) also appeared to have the more rounded edge profile. This provides some support for the hypothesis posed by Guillon,[48] but it does not provide conclusive proof. Future studies of noninvasive tear film quality, using custom lens designs to strictly control between lens parameters, may help to differentiate which of the contact lens material properties are most important in determining in vivo prelens tear film characteristics.

Subjective lens comfort scores did not correlate significantly with the decline of TFSQ but were consistent with previous study results showing a significant decrease in lens wear comfort in the afternoon.[49,50] The lack of correlation between lens comfort and TFSQ is not surprising given that most of our subjects were not adapted lens wearers; other

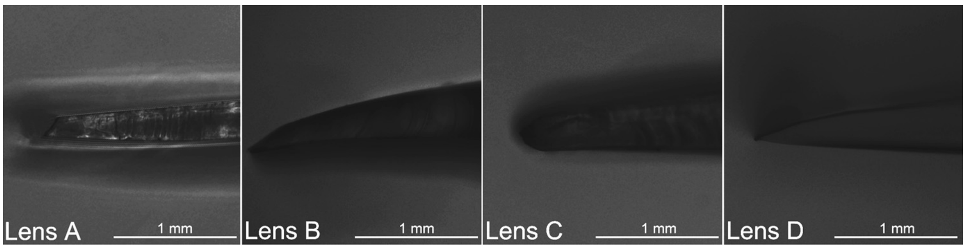

Figure 5. The edge profiles, imaged with phase-contrast microscopy, of the four considered soft contact lenses.

factors related to the mechanical or physiological influence of the lens on the ocular surface and not related to TFSQ might be expected to have a greater influence on the initial subjective lens comfort in unadapted subjects. However, it should be noted that being comfortable in the early stage of lens wear does not preclude the potential for cumulatively prolonged lens wear leading to clinically significant tear film abnormalities. Future research using more sophisticated methods for assessing subjective comfort, such as the just noticeable difference in ocular comfort[51] in adapted wearers, could provide better insight into the relationship between subjective comfort and TFSQ.

We believe that the main significance lies in the sensitivity of the techniques, which have the potential to reveal further details about tear film that traditional clinical methods may not be able to detect. Hence, it is plausible that the presented objective techniques for assessing TFSQ might be sensitive enough to record differences in TFSQ in the very early stages of lens wear (i.e., subclinical signs of tear film changes), which could potentially be indicative of future clinical symptoms of contact lens–induced dry eye (a stage when the tear film quality substantially worsens and the condition has a clearer clinical significance). Although further work is required to determine the exact clinical implications of the results obtained in this study, we hope that the sensitivity of the techniques presented here will enable future studies to better understand the connection between the different lens design parameters, TFSQ, and clinical signs and symptoms of contact lens–related tear film abnormalities. To summarize, noninvasive techniques of tear film surface assessment have the potential to effectively assess the influence of different material properties of soft contact lenses on prelens tear film surface quality. Lateral shearing interferometry proved to more effectively discriminate between lens types than the dynamic area HSV, but, in general, the two techniques provided comparable results. Future research using these techniques may help to provide further insight into the influence of lens design and material properties on the tear film.

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