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How should initial fit inform soft contact lens prescribing

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ABSTRACT

Purpose: To investigate how initial HEMA and silicone-hydrogel (SiHy) contact lens fit on insertion, which informs prescribing decisions, reflect end of day fit.
Methods: Thirty participants (aged 22.9 ± 4.9 years) were fitted contralaterally with HEMA and SiHy contact lenses. Corneal topography and tear break-up time were assessed pre-lens wear. Centration, lag, post-blink movement during up-gaze and push-up recovery speed were recorded after 5,10,20 min and 8 h of contact lens wear by a digital slit-lamp biomicroscope camera, along with reported comfort. Lens fit metrics were analysed using bespoke software.
Results: Comfort and centration were similar with the HEMA and SiHy lenses ($p > 0.05$), but comfort decreased with time ($p < 0.01$) whereas centration remained stable ($F = 0.036$, $p = 0.991$). Movement-on-blink and lag were greater with the HEMA than the SiHy lens ($p < 0.01$), but movement-on-blink decreased with time after insertion ($F = 22.423$, $p < 0.001$) whereas lag remained stable ($F = 1.967$, $p = 0.129$). Push-up recovery speed was similar with the HEMA and the SiHy lens 5–20 min after insertion ($p > 0.05$), but was slower with SiHy after 8 h wear ($p = 0.016$). Lens movement on blink and push-up recovery speed was predictive of the movement after 8 h of wear after 10–20 min SiHy wear, but after 5 to 20 min of HEMA lens wear.
Conclusions: A HEMA or SiHy contact lens with poor movement on blink/push-up after at least 10 min after insertion should be rejected.

1. Introduction

Dispensing a patient with well-fitting contact lenses is vital to reduce the probability of compromise to the ocular surface [1,2], and to maximise ocular comfort [3,4]. Therefore it is important contact lens practitioners are able to identify whether contact lens fit is adequate during the initial fit assessment. Recent research has defined the key clinical metrics that fully describe soft lens fit [5], however soft lens fit varies with time [2,6,7], requiring a settling period before lens fit stabilises, perhaps linked to changes in the post-lens tear film [2]. Contact lens movement on blink has been found previously to decrease for 30 min post-insertion [2,6], but the optimal predictability of lens fit 8 h post-insertion has been reported to be achieved 5 min post-insertion of HEMA (hydroxyethyl methacrylate) low [2] and high [2,6] water content lenses. However, the temporal dependency of centration, lag and push-up recovery speed have not been quantified, and the duration of the optimum settling time for silicone hydrogel lenses prior to lens fit assessment remains equivocal. Whilst the shape profiles of HEMA and silicone hydrogel contact lenses are similar, it is feasible the higher modulus of silicone hydrogel lenses may affect the temporal characteristics of lens movement.

The aim of the current study is to objectively [8] investigate the optimum settling time of HEMA and silicone hydrogel contact lens using the full range of key clinical metrics [5] in order to develop evidence-based clinical prescribing guidance for contact lens practitioners.

2. Methods

Thirty neophyte to contact lens wear participants aged 22.9 ± 4.9 years (10 male) were recruited following informed consent. Patients were screened to exclude those with a positive history of systemic disease, ocular disease or abnormalities (including corneal endothelial dystrophy, guttata, recurrent corneal erosion), corneal surgery, lenticular opacities, intraocular surgery, astigmatism >0.75 D, acuity >0.0 logMAR, amblyopia (>0.1 logMAR difference in visual acuity between eyes), heterotropia or anisometropia (>1.00 D mean spherical equivalent difference between eyes). Informed written consent was obtained from all

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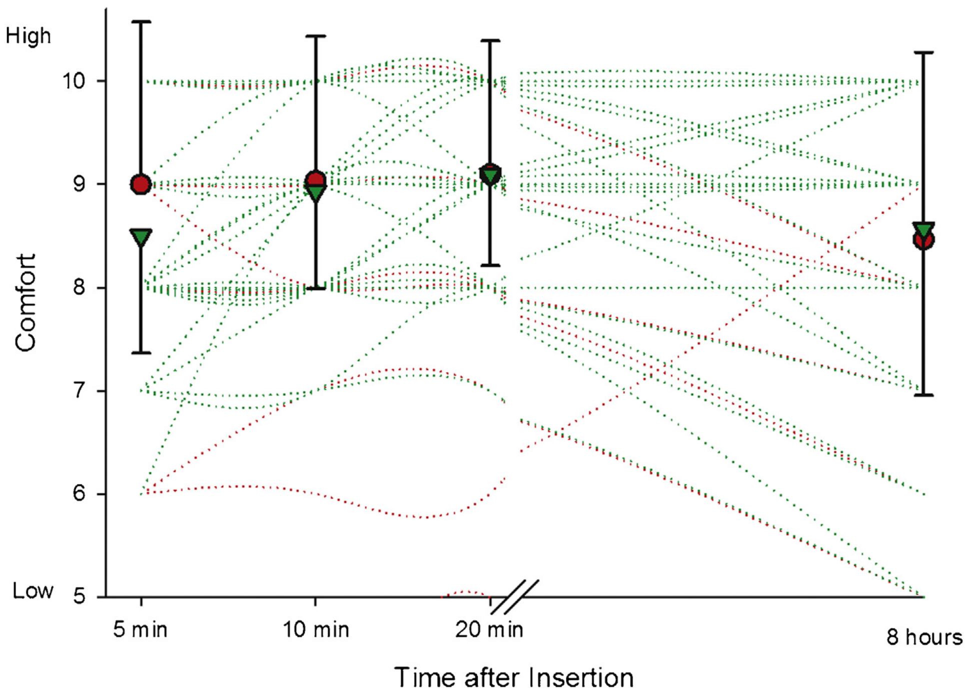

Fig. 1. Comfort (rated 0 to 10) with time after insertion for HEMA (red) and silicone hydrogel (green) wearing individuals (dotted lines) and on average (symbols with standard deviation error bars). $N = 30$.

the participants after an explanation of the nature and possible consequences of the study. The study was approved by the Aston University Research Ethics Committee and conformed to the tenets of the declaration of Helsinki.

Corneal topography in primary gaze and stitched with peripheral gaze (Medmont, Nunawading, Victoria, Australia), iris diameter and non-invasive tear break-up time (average of 3 viewed with the Tearscope, Keeler, Windsor, UK) was assessed at baseline. The participants were then fitted through random assignment with a HEMA contact lens (8.5/9.0 mm base curve Acuvue Moist, Johnson and Johnson, Jacksonville, USA) on one eye and a silicone-hydrogel contact lens (8.4/8.8 mm base curve Acuvue Oasys, Johnson and Johnson, Jacksonville, USA) on the other (selected at random) by the same experienced investigator within the range of average keratometry readings plus 0.6–1.0 mm.

At 5 min, 10 min, 20 min and 8 h post-insertion, participants were asked to rate their comfort on a 0 (extreme discomfort) to 10 (could not feel) scale. Push-up speed of recovery was rated subjectively as slow (<2 mm/s)/medium (2–4 mm/s)/fast (>4 mm/s) following digital displacement and centration, blink on upgaze, and horizontal lag were dynamically captured using a digital slit-lamp biomicroscope (CSO, Florence, Italy) at 6× magnification (resolution 1392 × 1024 pixels, frame rate 11 Hz) by a different investigator ensuring each video was adequate for subsequent analysis.

A separate masked observer objectively analysed the resulting videos (all right eyes followed by all left eyes) using a purpose-developed image analysis program (LabVIEW, National Instruments, Austin, Texas), as described previously [8]. Lens centration was determined from the difference in millimetres between the centre of circles adjusted to circumscribe the visible pupil and contact lens edge taking into account both horizontal and vertical axis. Movement on blink in up-gaze was assessed by the change in vertical lens position relative to the cornea from the first video frame after the blink until the lens was stabilised. Horizontal version lag was assessed as the difference in millimetres between the limbus to lens edge distance, from the primary gaze position to nasal- and temporal-gaze. The analysis was performed three times and the results averaged. Imaging a graticule through the same slit-lamp and camera system determined the calibration as 1 pixel being equivalent to 0.016 mm. After analysis, the eyes were reassociated with the lens they had worn for analysis by the researcher who had conducted the randomisation.

2.1. Statistical analysis

As the present study evaluated lens fit characteristics between techniques of assessment, rather than between eyes (a different lens type was worn in each eye), both eyes data was involved within the analysis. The Kolmogorov–Smirnov test was used to evaluate the normality of the data distribution with normally distributed data evaluated with parametric statistics. Objective data was analysed by repeated measure analysis of variance and Pearson's correlations whereas subjective data was analysed with related-samples Friedman's two-way Analysis of Variance by Ranks and Spearman rank correlations. All the videos allowed successful analysis. The results were considered statistically significant when the p value was less than 0.05. All statistical analysis was performed using SPSS for Windows statistical software (version 20, SPSS, Inc., Chicago, USA).

Table 1
The correlation coefficient of comfort, centration, blink, lag and push-up after 5, 10 and 20 min of HEMA and silicone hydrogel lens wear compared to after 8 h of wear. $N = 30$.

Correlation	HEMA			Silicone hydrogel		
with 8 h	5 min	10 min	20 min	5 min	10 min	20 min
Comfort	0.760**	0.739**	0.771**	0.348	0.592*	0.684**
Centration	0.090	0.127	0.318	0.046	0.073	0.027
Blink	0.725**	0.723**	0.830**	0.732**	0.870**	0.900**
Lag	0.413*	0.699**	0.673**	0.581*	0.684**	0.743**
Push-up	0.559*	0.419*	0.530*	0.289	0.402*	0.451*

* = $p < 0.05$.
** = $p < 0.001$.