



Brief report

Tear Deformation Time and optical quality in eyes wearing silicone hydrogel contact lenses

Amir Asharlous^{a,b,*}, Ebrahim Jafarzadehpur^c, Ali Mirzajani^b, Mehdi Khabazkhoob^d,
Samira Heydarian^e, Ali Taghipour^f

^a Optometry Department, Mashhad University of Medical Sciences, Mashhad, Iran

^b Optometry Department, Iran University of Medical Sciences, Tehran, Iran

^c Noor Research Center for Ophthalmic Epidemiology, Noor Eye Hospital, Tehran, Iran

^d Department of Medical Surgical Nursing, School of Nursing and Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran

^e Department of Optometry, School of Paramedical Science, Mashhad University of Medical Science, Mashhad, Iran

^f Department of Epidemiology & Research Methodology, Faculty of Health, Mashhad University of Medical Sciences, Mashhad, Iran

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Abstract

Purpose: To evaluate tear film stability and optical aberrations in eyes wearing plano Lotrafilcon B contact lenses (CL).

Methods: Tear Deformation Time (TDT) and aberrometric parameters were assessed in 86 normal emmetropic eyes before and 6 h after wearing CL.

Result: A statistically significant decrease in TDT and increase in root mean square (RMS) values of higher order aberrations (HOA) were revealed 6 h after CL insertion (both $P < 0.001$). The low order aberrations (LOA) RMS values measured with CL were higher than those in naked eyes, but the difference was not statistically significant. None of individual Zernike polynomials showed any significant alteration.

Conclusion: Our findings indicated that the Lotrafilcon B contact lens affects HOA more than LOA. The tear film was less stable after wearing CL. Copyright © 2016, Iranian Society of Ophthalmology. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Keywords: Tear stability; Tear Deformation Time; Aberrations; Optical quality; Silicone hydrogel contact lens

Introduction

Contact lenses (CL) are widely used to improve vision in eyes with refractive error. The corneal surface, however, may be affected by using the contact lens.¹ Tear film stability time is an important measure of the quality of the tear film.² The pre-lens tear stability is dependent on lens material characteristics, tear film properties, and lens–tear interaction.¹ Our

study attempts to address the effect of a silicone hydrogel contact lens, Lotrafilcon B, on tear film stability and optical aberrations of the eye.

Methods

Eighty-six eyes of 43 emmetropic subjects (refractive error within ± 0.50) with a mean age of 19.55 ± 1.63 (range 18–23) years old comprised of 22 females and 18 males were entered in this study. Ethical clearance was obtained through the office of research ethics at Iran University of Medical Sciences.

Refraction and keratometry for each subject was implemented by utilizing the Auto ref –keratometer. No ocular diseases or surface staining were seen in our volunteers. Low and higher order aberrations (HOA) were measured by using

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* Corresponding author. No. 37/6, Arghavan 3 St., Donyamali Ave., Andisheh phase 1, Tehran, Iran.

E-mail address: Asharlous.a@iums.ac.ir (A. Asharlous).

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Table 1

Mean and standard deviation (M ± SD) of the tear stability and aberrometric parameters for both right and left eyes in both naked and contact lens inserted status.

	Right eye			Left eye		
	LOA (μm)	HOA (μm)	TDT (sec)	LOA (μm)	HOA (μm)	TDT (sec)
Without CL	0.195 ± 0.134	0.148 ± 0.095	9.82 ± 5.14	0.176 ± 0.117	0.124 ± 0.080	9.60 ± 4.58
With CL	0.247 ± 0.160	0.224 ± 0.149	5.15 ± 2.34	0.204 ± 0.112	0.170 ± 0.128	5.08 ± 2.61
P value	0.06	0.002	<0.0001	0.08	0.003	<0.0001

Tear Deformation Time (TDT); RMS (Root Mean Square); LOA (Low Order Aberrations); HOA (Higher Order Aberrations); μm (Micrometer); Sec (Seconds).

an objective aberrometer (HUVITZ, HRK 8000A, Korea). Root Mean Square (RMS) values of both low and HOA were calculated for 5.09 mm pupil sizes. Moreover, twelve Zernike coefficients were recorded. In addition, tear film stability was assessed for both eyes. To measure stability time, the non-invasive Tear Deformation Time (TDT) technique was applied.^{3,4}

After completing the aberrometry and TDT tests, a Plano powered silicone hydrogel contact lens (Air Optix Aqua, Lotrafilcon B, CIBA vision) was inserted into both right and left eyes. After 15 min elapsed to stabilize the lens on the cornea, fitting properties of the contact lens were evaluated. After achieving a good fit, the subjects were asked to stay 6 h with the lenses and perform their normal routine.

Six hour after insertion of the contact lens, wave front aberrometry was repeated for their eyes. TDT was measured over the lens surface and recorded as Pre-Lens Tear Deformation Time (PL-TDT). At the end of these tests, CL were removed. Statistical analysis was performed using paired t test.

Results

Mean and standard deviation of the TDT and RMS values of low and HOA before and after contact lens insertion are summarized in Table 1.

In all eyes, pre-lens TDT was significantly lower than the pre-corneal (before contact lens insertion) TDT ($P < 0.001$). HOA-RMS values showed a significant increase after inserting the CL ($P < 0.004$). There were no significant changes in the other variables including LOA-RMS and individual 12 Zernike polynomials. The TDT results of the right eyes in both before and after lens wearing strongly correlated with data of the left eyes (Before: Pearson's $r = 0.908$, $P < 0.0001$ /After: Pearson's $r = 0.928$, $P < 0.0001$).

Discussion

In good agreement with previous studies, our findings showed that the silicone hydrogel CL increase HOA in the optical system of the eye.^{5,6} The variation of optical aberrations during the lens wear can be attributed to many factors, including lens centration relative to the corneal center, lens-to-cornea fitting relationship, optical quality of the contact lens, and pre-lens tear film status.^{7,8} The first two factors were

controlled as much as possible during the measurements. Optical quality was constant in all subjects because of selection of the plano CLs for this study. It seems the final factor, tear film dynamicity, played an important role in the alteration of the optical feature of the eye. It seems that the tear film on the contact lens surface is less stable than over the corneal surface. These findings have good consistency with previous studies.^{9,10} Numerous studies have demonstrated that changing in tear film dynamicity and its break up can add optical aberrations¹¹ and consequently, give rise to distorted retinal image quality.^{12,13} Therefore, CL-induced tear instability can be an important factor to increase the wavefront aberrations.

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