Brief report

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

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Received 3 April 2016; revised 1 July 2016; accepted 2 July 2016
Available online 25 July 2016

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.

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.3

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
showed that the silicone hydrogel CL increase HOA in the
discussion.

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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 (HUVIDTZ, 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 Defor-
mation 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 Zer-
nike 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 selec-
tion 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 chang-
ing 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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