Does Tear Exchange Differ Between Silicone Hydrogel Contact Lens Types?

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INTRODUCTION

- Silicone hydrogel contact lenses were developed to meet the oxygen transmissibility requirements of overnight contact lens wear.

  Thought that with increase in oxygen permeability, corneal hypoxia, infection, and inflammation would disappear.[2]
- Even though silicone hydrogel (SiHy) contact lenses have provided the corneal surface with exceptional oxygen levels, problems with corneal inflammation and infection have still been observed.[3]
- The annualized incidence of microbial keratitis per 10,000 wearers was 1.9 for daily wear soft contact lens wearers and 11.9 for daily wear silicone hydrogel contact lens wearers.[4]
- One possible explanation may be tear stagnation under the contact lens due to insufficient tear exchange.
- Tear exchange is important for clearing debris and cellular material from the corneal surface.[5,6,7,8]
- Tear exchange is the measure of the difference in tear film fluorescence after the instillation of fluorescein over time using a fluorophotometer.[9]
- The purpose of this study was to determine the tear exchange rate in seven different silicone hydrogel contact lens materials using an in vivo fluorophotometer on 15 patients and compare these results to a control non-silicone hydrogel contact lens in order to determine if contact lens movement or lens modulus plays a role in tear stagnation.

MATERIALS AND METHODS

- Subject Demographics and Inclusion Criteria
  - 15 adapted soft contact lens wearers were enrolled.
  - Average age: 22.75 (22-26 years)
  - Subjects completed an informed consent with protocol approved from the University of Houston Committee on Human Subjects
  - Each subject was free of ocular disease, ocular irritations, corneal staining, or severe dry eye determined by biomicroscopy and the Ocular Surface Disease Index.
- Objective and Subjective Measurements
  - Ocular surface health was assessed with biomicroscopy
  - Corneal astigmatism and elevation-measured Bausch and Lomb Orbscan™
  - Blink rate was measured
  - Vertical and horizontal lens movement quantified using biomicroscopy with calibrated measuring grid
- Tear Clearance Measurement
  - Subjects were scheduled to wear three of the total eight contact lenses available. Selection of the contact lenses was randomized and subjects were masked as to which contact lens they were wearing.
  - Ocular fluorescence without a contact lens of interest was measured with OcuMetrics FM-2 Fluorotron™ Master Ocular Fluorophotometer
  - Contact lens baseline fluorescence was also measured
  - 1 µl of 5% FITC-dextran (Greenpark Pharmacy), a high molecular weight sodium fluorescein, was instilled using a micropipette onto the concave portion of the lens and carefully applied to the corneal surface
  - Fluorophotometry was performed every 4-5 minutes until contact lens baseline fluorescence was reached.
  - Measurements were taken at different times during the day on different days
  - Raw data produced by the fluorophotometer was converted into a peak number which was then graphically represented using Kleidograph
  - The first 5 minutes was excluded to allow for lens stabilization
  - Peak number= (raw data number minus contact lens baseline fluorescence) divided by (maximum peak number minus contact lens baseline fluorescence)
  - All peaks were then normalized to one in which one signified the highest overall peak in that particular trial.
- Contact Lenses Assessed
  - All contact lenses were -3.00 diopters to control for lens thickness
  - Lotrafilcon A- 8.6 base curve, 13.8 diameter
  - Lotrafilcon B- 8.6 base curve, 14.2 diameter
  - Etafilcon A- 8.7 base curve, 14.0 diameter
  - Galyfilcon A- 8.7 base curve, 14.0 diameter
  - Senofilcon A- 8.8 base curve, 14.0 diameter
  - Comfilcon A- 8.6 base curve, 14.0 diameter
  - Balafilcon- 8.6 base curve, 14.0 diameter
  - Enfilcon- 8.5 base curve, 14.2 diameter

RESULTS

Fig. 1

- The raw data shown here is converted into a peak number which then can be graphed in Kleidograph.
  - Formula used to convert: Peak # =(# to be converted minus baseline)/ (max. peak # minus baseline)
  - All peaks were then normalized to 1, which signified the highest overall peak

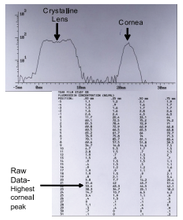
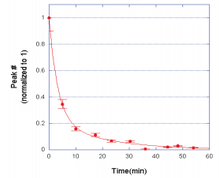


Fig. 2



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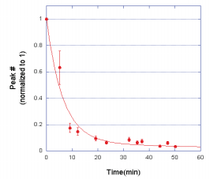


Table 1 **Average Vertical Contact Lens Movement (mm)**

Contact Lens	Average Movement (mm)	Std. Deviation
Lotrafilcon A	0.48	0.08
Lotrafilcon B	0.31	0.09
Comfilcon A	0.29	0.10
Balafilcon	0.26	0.09
Etafilcon	0.26	0.05
Enfilcon	0.24	0.09
Galyfilcon A	0.21	0.02
Senofilcon A	0.14	0.05

Fig. 4

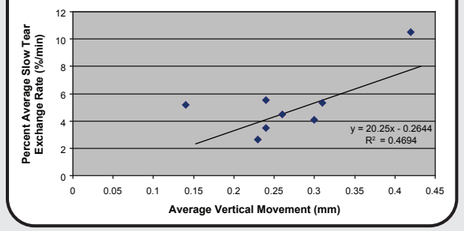


Fig. 5

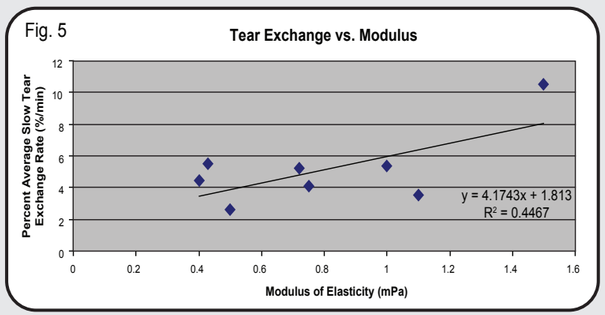


Fig. 6

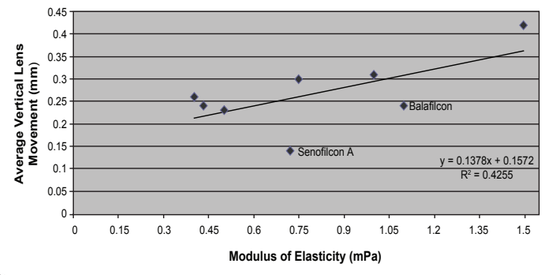
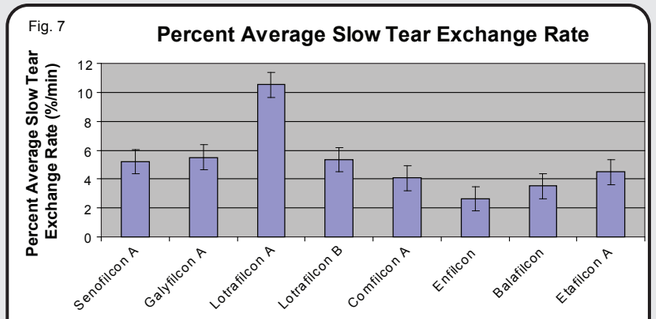


Fig. 7



CONCLUSION

- Lens movement and tear exchange rate were not statistically different between silicone and non-silicone hydrogel contact lenses.
- The slow decay rate was different between individual silicone hydrogel contact lenses ranging from2.62% to 10.51%.
- Subjects showed a higher than normal blink rate of 18 blinks per minute with the general average blink rate being 15 blinks per minute.
- Modulus of elasticity versus slow decay rate and lens movement versus slow decay rate both showed a positive correlation resulting in a greater decay with increased movement and higher modulus.
- The results suggest that differences in individual silicone hydrogel lenses were exhibited due to the biophysical differences between lenses.

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