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Critical Coefficient of Friction of In-Vitro Spoiled Soft Contact Lenses

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Abstract

Purpose

Minimal sliding friction of a soft contact lens (SCL) is essential to wear comfort. To establish whether prolonged lens wear influences friction, we implemented the inclined-plane method to measure the critical coefficient of sliding friction (CCOF) of commercial SCLs after in-vitro spoliation in a model-blink cell that simulates on-eye wear.

Methods

HEMA-based (1-DAY ACUVUE, SofLens 38), silicone-based for both extended wear (O2 OPTIX, ACUVUE OASYS, PureVision, Night & Day) and daily disposable (DAILIES TOTAL1, 1-DAY ACUVUE TruEye) SCLs were investigated for sliding friction after spoilation in an in-vitro model-blink cell with artificial-tear solution (ATS), including proteins, mucin, and artificial tear lipids. The in-vitro model-blink cell replicates the physical process of on-eye lens fouling leading to discrete surface deposits (Razunguzwa et al, ARVO 2013 E-5488). After fouling, each lens is immersed in PBS and the CCOF values determined by a modified inclined-plane method adapted from Tucker et al. (ARVO 2012 E- 6093). The CCOF characteristic of initial sliding motion was calculated as tan[sin-1(h/l)] where h is the height of a glass plate at sliding commencement and l is the length of the plate.

Results

For unfouled (clean) lenses in Fig. 1, the HEMA/MAA-based 1-DAY ACUVUE displayed the highest CCOF value and the silicone-based daily disposable SCL (DAILIES TOTAL1, 1-DAY ACUVUE TruEye) displayed the lowest CCOF value. Measured CCOF values are not correlated to the water contents of the lenses. As the number of spoilation cycles increases, CCOF values for the HEMA-based SCL (Fig. 2) remained constant and approximately equal to the clean value. For the silicone-based SCLs

(Fig. 2), however, CCOFs increased with increasing amount of spoilage. These results are consistent with the finding that lipid deposition during wear is more pronounced on silicone-hydrogel lenses than on HEMA-based lenses.

Conclusions

To our knowledge, this study is the first to investigate the sliding lubricity of contact lenses characteristic of on-eye wear. Spoilation increases CCOF by creating congealed surface deposits (jelly pumps). The effect of spoilation on CCOF of SCLs depends on surface composition of the SCL with more hydrophobic surfaces evidencing larger amounts of lipid contamination and higher sliding friction.

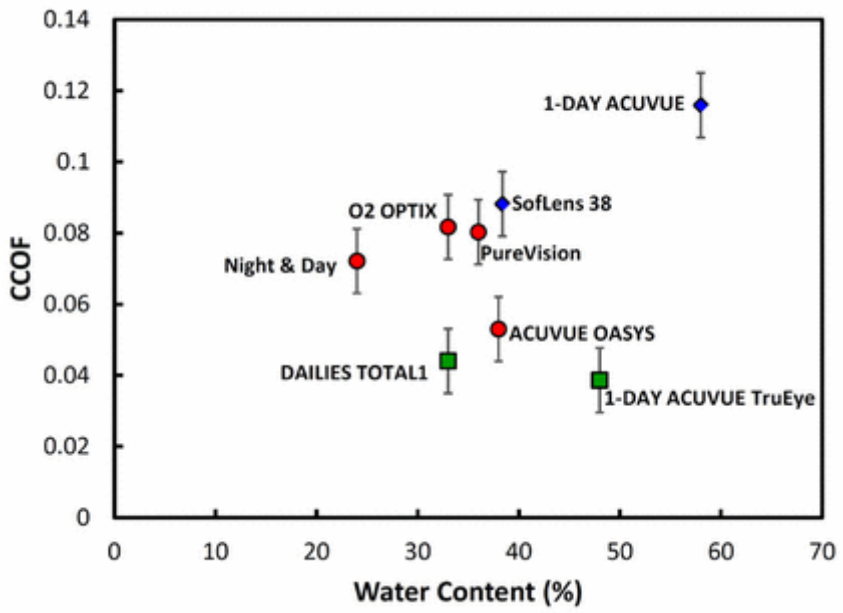

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Fig. 1. CCOF values vs. water content for clean SCLs.

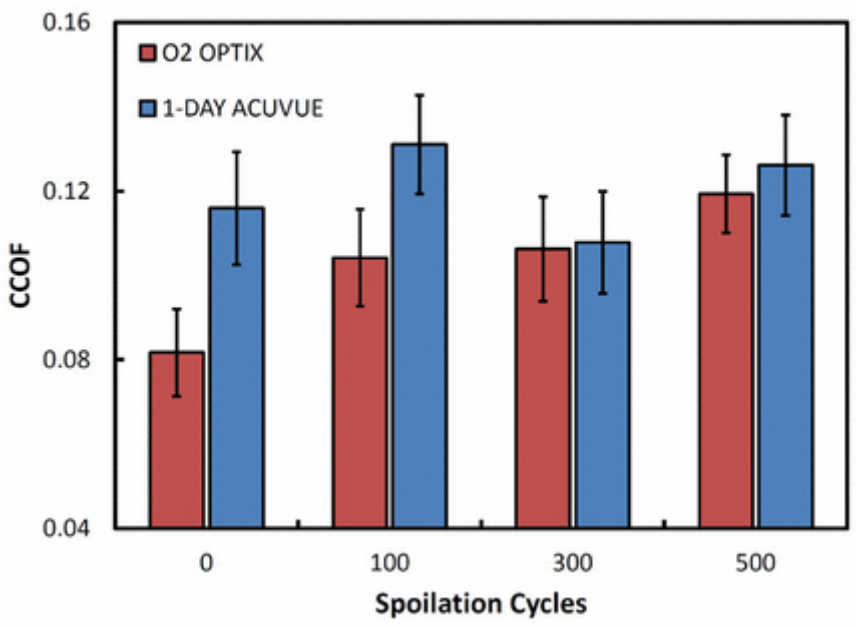

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Fig. 2. CCOF values for clean and spoiled SCL.

Keywords: 477 contact lens