Tangible Hydra-PEG Coating of GP Lenses Improves Wettability and Lubricity

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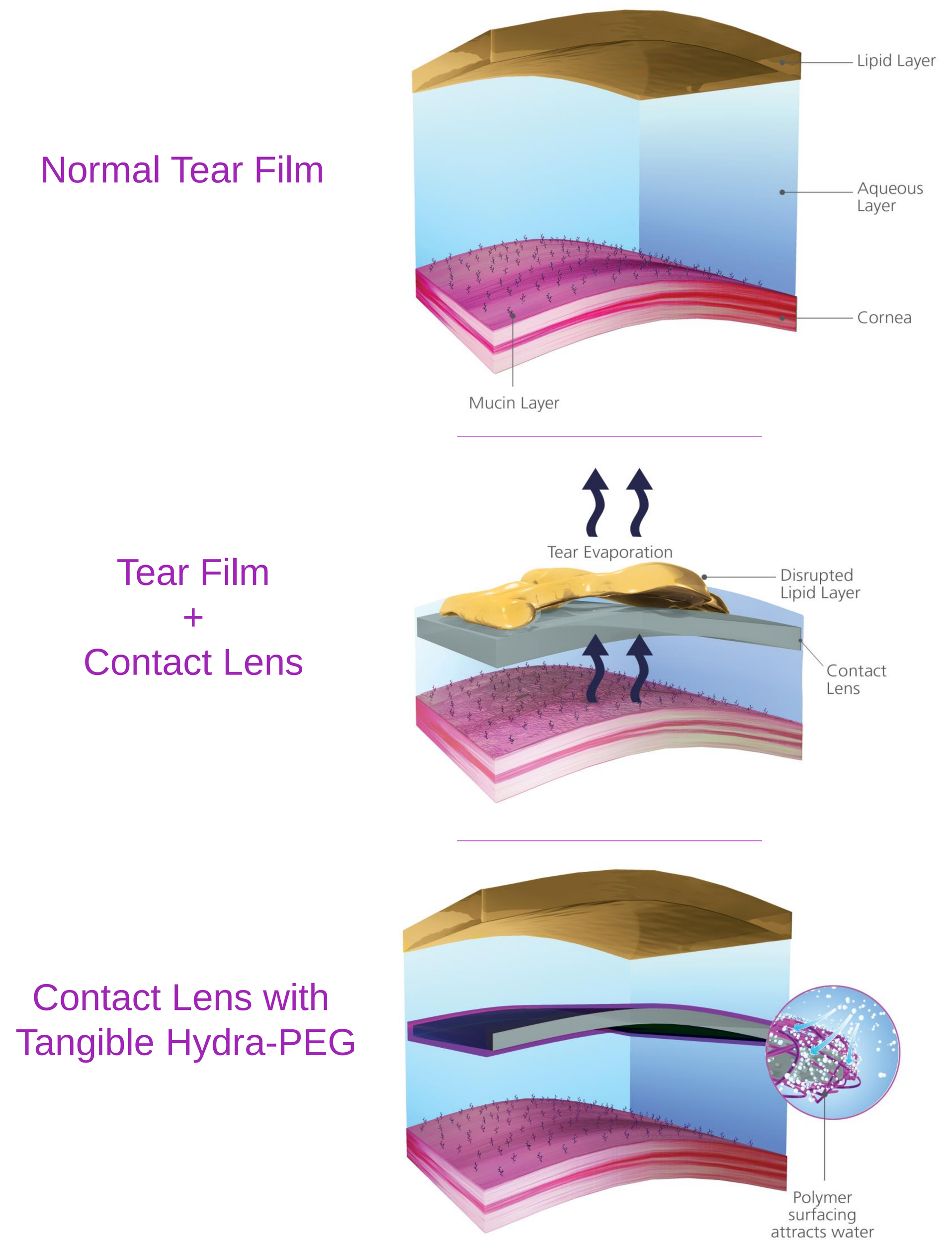
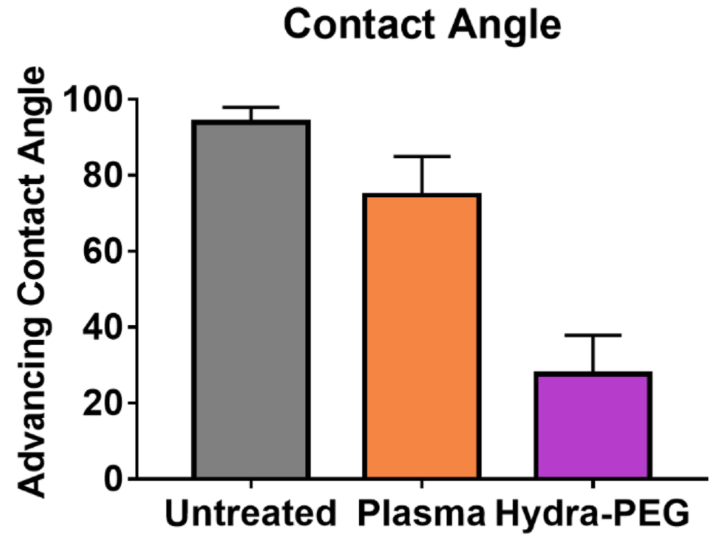
Introduction

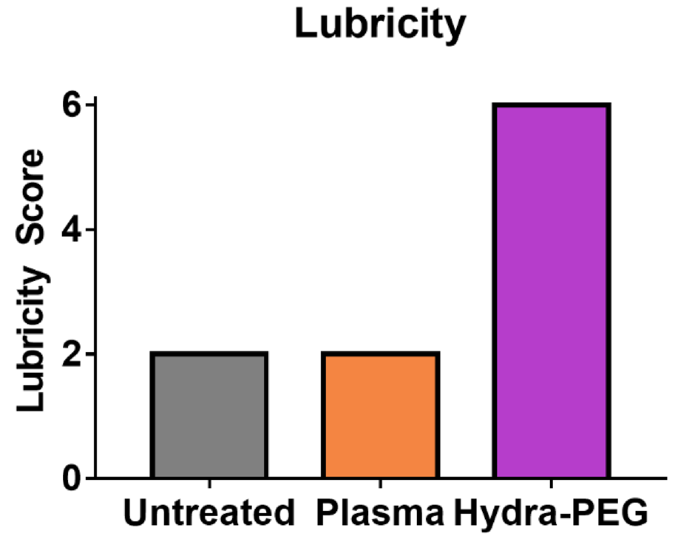
Lack of comfort is a leading cause of discontinuation of contact lens wear. Both wettability and lubricity have been associated with patient comfort yet can be difficult to control over longer time scales with conventional materials. Tangible Hydra-PEG is a PEG-based polymer hydrogel that is covalently attached to a contact lens surface. The goal of this study was to determine whether the Tangible Hydra-PEG surface coating improves wettability and lubricity of gas permeable (GP) contact lenses.



Methods and Results

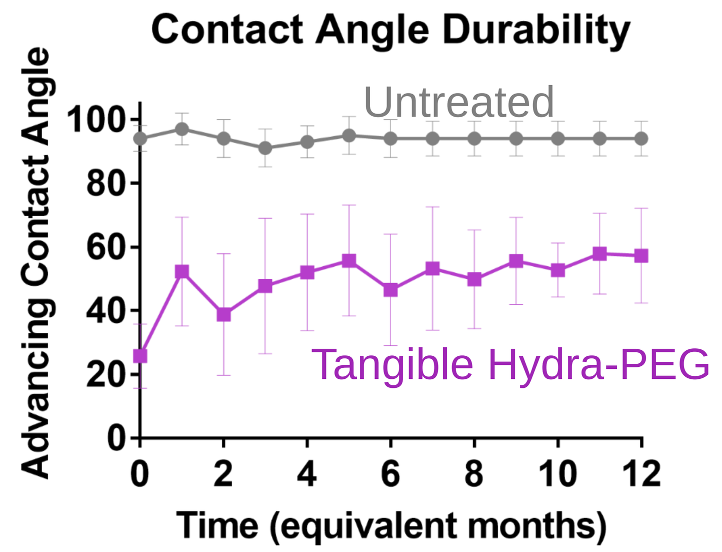
Tangible Hydra-PEG Improves Contact Angle and Lubricity

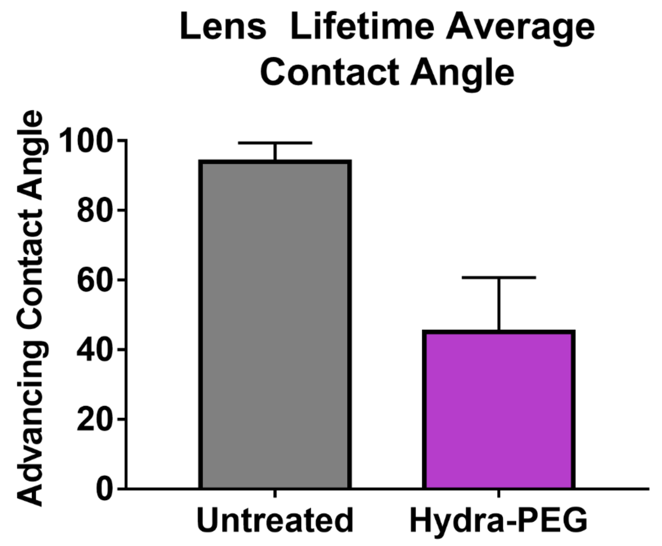




GP lenses were coated with Tangible Hydra-PEG, a polyeythylene glycol-based hydrogel network that is covalently attached to the lens surface. Advancing contact angles were measured using the dynamic captive bubble technique.[1] Tangible Hydra-PEG improved the wettability of the lens, as shown by the dramatic reduction in contact angle. This treatment also resulted in a vast improvement in lubricity. While plasma improves lens wettability immediately after treatment, these gains are quickly reduced, as evidenced by the high contact angle measured 24 hr after plasma treatment. This time point was chosen to represent the minimum elapsed time between lens manufacturing and dispensing.

Tangible Hydra-PEG Coating Durability

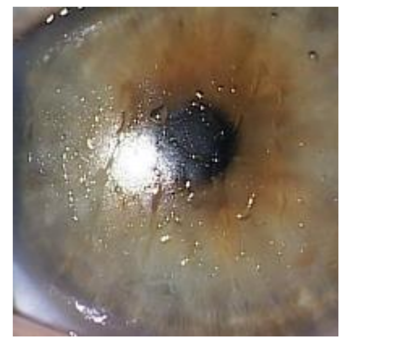




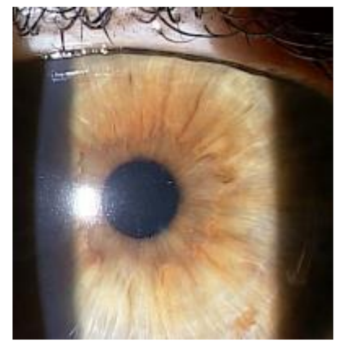
Durability of the Tangible Hydra-PEG coating on GP lens material was assessed after manual rubbing to simulate daily cleaning cycles (20 s per day in Unique pH multipurpose solution). Contact angle measurements showed that Tangible Hydra-PEG improved wettability throughout the 12 month lifetime of the lens. When the contact angle measurements throughout the lifetime of the lens are

On-Eye Wettability with Tangible Hydra-PEG

On-eye images of scleral GP lenses show improved wettability with Tangible Hydra-PEG (right) compared to plasma-treated lenses (left).

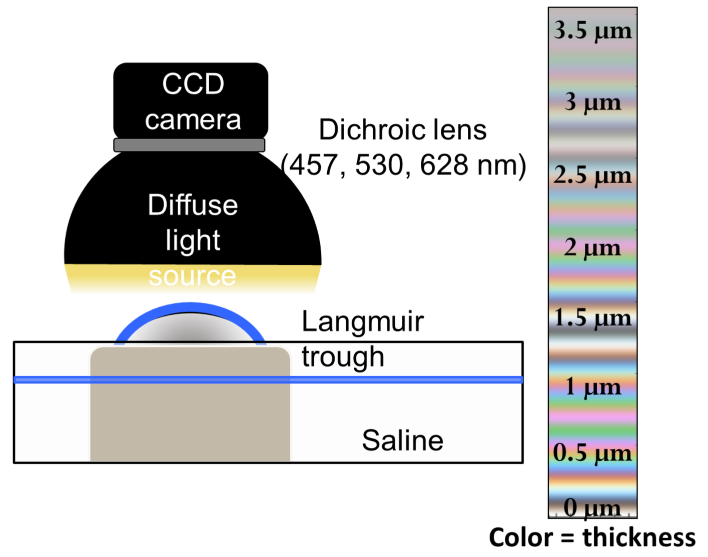


Plasma-treated

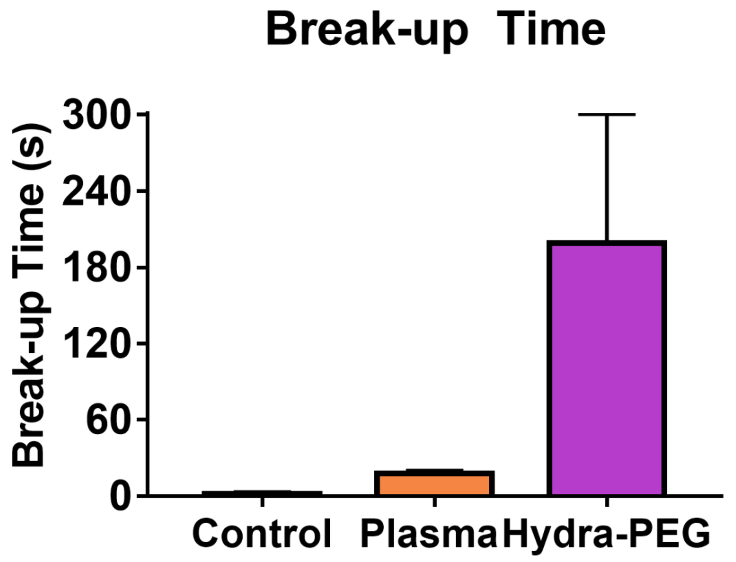


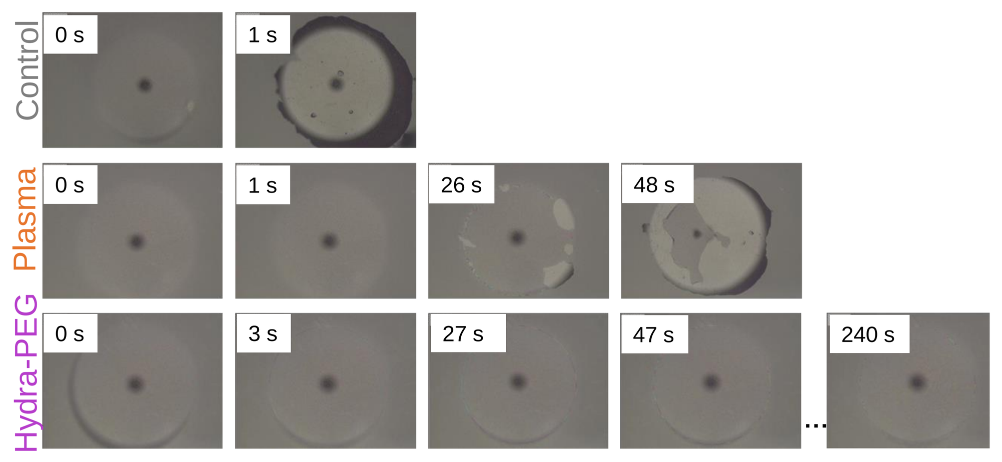
Tangible Hydra-PEG

Quantification of Interfacial Drainage and Dewetting

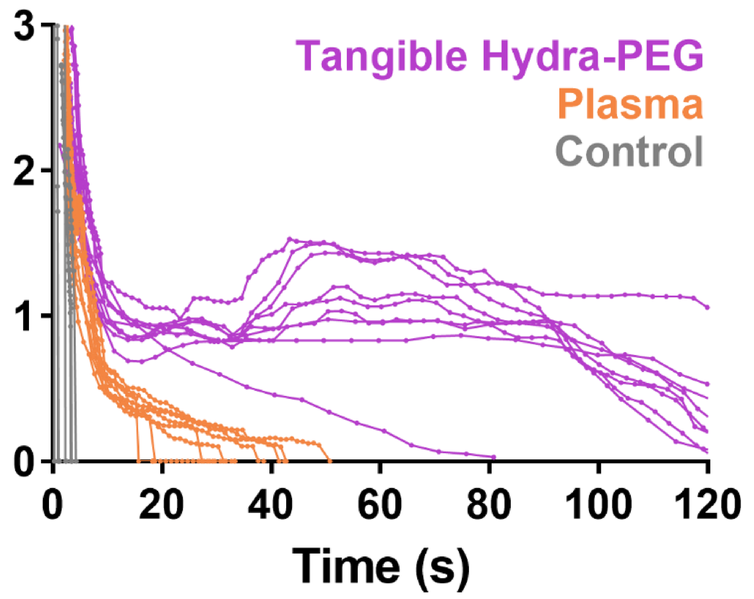


Scleral GP lenses were quantified using the Interfacial Drainage and Dewetting Optical Platform (i-DDrOP).[2] A lens was placed on a dome and submerged in the saline-filled Langmuir trough. The lens was then elevated through the air–liquid interface using a motorized stage which captured a thin layer of fluid on the lens. Dewetting images were acquired through the use of a diffuse light source filtered through a dichroic lens and captured with a CCD camera.





Videos showed almost immediate dewetting of the untreated lens (<2 s). Plasma treatment somewhat increased the amount of time before break-up (~17 s), but Tangible Hydra-PEG treatment resulted in a stable saline film for over 180 s. Thin film interference analysis was used to track the film thickness over time, showing that the Hydra-PEG coating preserves a film ~1 µm thick for over a minute.



Conclusions

Hydra-PEG improves both wettability and lubricity of GP lenses. This coating can be applied to both corneal and scleral lenses. Unlike temporary surface treatments such as plasma, the hydrophilicity of the lens was maintained for 12 months of simulated use. These surface properties have been associated with increased patient comfort, both in past studies and in clinical studies performed with Hydra-PEG materials, which will be reported separately. In addition, this surface coating improved maintenance of the tear film on contact lenses, which could improve visual acuity.

Tangible Hydra-PEG can provide a number of benefits to both patients and eye care practitioners.

- Enhanced practice satisfaction: enables physicians to satisfy patients over the long term and focus on fitting more patients, rather than refitting the same patients.
- Increased patient comfort: designed to dramatically improve comfort and wearing time for custom contact lens wearers.
- Patient convenience: makes the custom contact lens experience more pleasant for patients, by freeing them from rewetting drops and reducing deposits that require mid-day cleanings.
- Reduced lens return rate: by virtue of improved wettability.

References

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2) M. Saad Bhamla, Chew Chai, Noelle I. Rabiah, John M. Frostad, Gerald G. Fuller; Instability and Breakup of Model Tear Films. *Invest. Ophthalmol. Vis. Sci.* 2016;57(3):949-958. doi: 10.1167/iovs.15-18064.

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