On-eye dehydration and corneal staining

Dr Jeffery Schafer looks at on-eye dehydration and corneal staining of three daily disposable contact lenses in a low humidity environment and finds a new high water content material results in minimal dessication

Approximately 60 per cent of contact lens wearers who experience symptoms of blurry or fluctuating vision feel that these symptoms have a negative impact on contact lens comfort.[1] Contact lens wearers feel annoyed, frustrated, uncomfortable, and irritated by these symptoms.[1] It may be that their contact lenses are to blame. As lenses dry out over the course of the day, the shape of the lens can change. This shape change can have a negative effect on the optical surface of the lens. As a result, visual quality and comfort may be negatively impacted. New materials that maintain moisture and provide stable optics can help reduce symptoms and feelings of frustration associated with these symptoms.

Previous research comparing high-water hydrogel contact lenses (60-70 per cent water) to lower-water lenses (38 per cent water) has demonstrated greater prevalence of desiccation staining in the high-water lenses.[2,3] Water loss from soft contact lenses has been associated with changes in the hydrogel material characteristics including decreased oxygen transmission,[4,5] tighter fitting lenses,[5,6] change in lens power,[7] decreased visual performance,[8] and increased surface deposits.[5]

A unique hydrogel lens polymer

A unique hydrogel contact lens polymer, nesofilcon A (Biotrue Oneday) was developed with the following bio-inspired properties: an outer surface designed to mimic the lipid layer of tear film to prevent dehydration and maintain consistent optics, the same water content as the cornea, 78 per cent, to have a more natural balance of oxygen and water and provide a contact lens option that is biocompatible with the cornea, and the oxygen transmission level the open eye needs to maintain healthy, white eyes.

To evaluate the water loss and corneal response of this novel lens polymer (centre thickness = 0.100mm) compared to a 58 per cent water etafilcon A lens (centre thickness = 0.084mm) and a 48 per cent water narafilcon B lens (centre thickness = 0.085mm) in a low humidity environment, two studies were conducted in a humidity controlled room of 6 per cent relative humidity. Twenty-two subjects completed a four-hour, randomised, double-masked study comparing the novel 78 per cent water nesofilcon A lenses to 58 per cent water etafilcon A lenses. In a second case, 25 subjects completed a study following the same methodology with 48 per cent water narafilcon B lenses as the control.

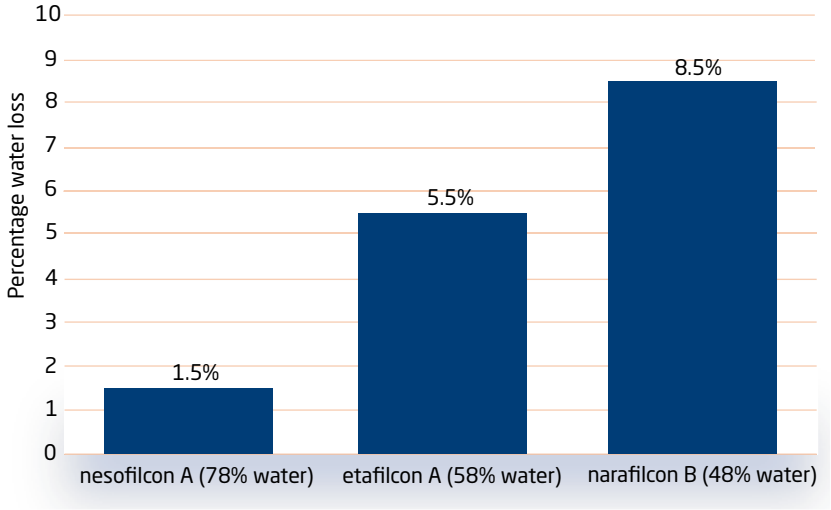

Figure 1 Mean on eye dehydration represented as percent water loss for each of the three lens types tested

Following insertion of a randomly assigned lens pair, each subject rated comfort and movement was assessed by the investigator. After four hours of lens wear, the above tests were repeated. The lenses were then removed, and each lens was immediately weighed (wet weight). The lenses were then completely dried and reweighed (dry weight). The water content was then calculated for each lens from the wet and dry weights using the following equation.

$$\frac{(\text{wet weight} - \text{dry weight}) \times 100}{\text{wet weight}}$$

Additionally, corneal staining was assessed at four hours. Paired t-tests were used to determine a difference in percentage water loss between lens types. The corneal staining data were analysed using the Wilcoxon Matched Pairs test.

Water loss, comfort and movement

The 78 per cent water nesofilcon A lenses lost significantly less water compared to the 58 per cent etafilcon A lenses and the 48 per cent water narafilcon B lenses, with mean water losses of 1.5 per cent, 5.5 per cent, and 8.5 per cent, respectively ($p<0.01$ in both cases), Figure 1. The highest individual water losses with respect to unworn controls were 3.1 per cent for the nesofilcon A lenses, 11.4 per cent for the etafilcon A lenses, and 16.4 per cent for the narafilcon B lenses.

There were no clinically significant differences between the three lens types for mean movement. Likewise, each of the three lens types exhibited good levels of comfort at insertion and

after four hours in the low humidity environment.

Corneal staining

Upon slit-lamp examination following four hours of lens wear, no subjects exhibited desiccation staining patterns in the eyes wearing the 78 per cent water nesofilcon A lenses or the 48 per cent water narafilcon B lenses. There was one observation of coalesced inferior corneal staining that was representative of desiccation staining in one eye that wore an etafilcon A lens. (Figure 2).

Conclusions

These studies demonstrated that the unique hydrogel contact lens polymer (nesofilcon A), which was designed to mimic the lipid layer of the tear film, prevents dehydration and therefore can maintain a steady optical surface without blur. The unique bio-inspired hydrogel contact lens polymer (nesofilcon A) also prevented dehydration better than the conventional hydrogel and silicone hydrogel materials tested. The novel 78 per cent water nesofilcon A contact lenses lost significantly less water than both the 58 per cent etafilcon A lenses and the 48 per cent water narafilcon B lenses. In addition, while high water content hydrogel contact lenses have historically resulted in desiccation staining, the 78 per cent water nesofilcon A hydrogel lens showed no evidence of corneal desiccation staining after four hours in a low humidity environment.

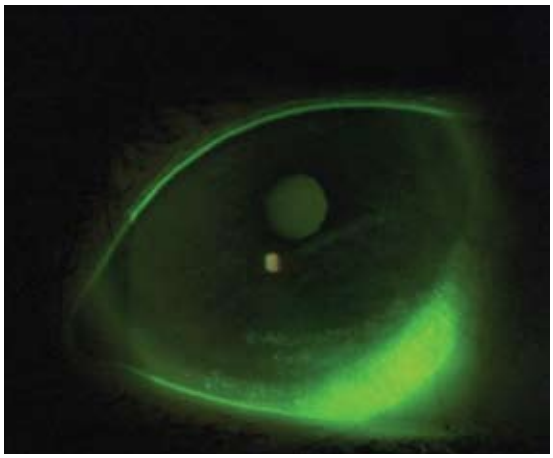

Figure 2 Corneal staining photo of subject showing inferior coalesced staining in an eye that wore the etafilcon A lens

References

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