In Vitro Bulk Dehydration Rates of Hydrogel and Silicone Hydrogel Daily Disposable and Frequent Replacement Contact Lens Materials

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Introduction

- The first comprehensive study investigating contact lens drop out was conducted almost 20 years ago[1] and indicated that end of day dryness and discomfort was the most common reason for ceasing contact lens wear, with approximately 50% of wearers citing this as their primary complaint with lenses.
- Despite the advances in contact lens materials since that time, patients are still "dropping out" of contact lens wear as a result of discomfort,[2-5] with studies suggesting that 22-24% of patients permanently discontinue contact lens wear [2,4] and that contact lens wearers are 12 times more likely than emmetropes and five times more likely than spectacle-wearers to report dry eye symptoms. [6]
- One of the factors often stated as being important in contact lens-related dry eye relates to bulk material dehydration, as dryness symptoms appear to occur more frequently in soft lens wearers whose lenses undergo greater dehydration. [7]
- Studies have shown that bulk material dehydration is influenced by a number of factors, including:
  - the surrounding environment [8]
  - water content (with higher water content materials dehydrating more) [9-11]
  - water binding properties [12]
  - thickness (with thin lenses dehydrating more than thick lenses) [13]
- Recent studies suggest that polyHEMA-based higher water content materials are more likely to be associated with dry eye symptoms.[14-16]
- Several studies have indicated that silicone hydrogel materials (which are all relatively low water content) may prove beneficial in the management of patients with symptoms of ocular dryness. [5, 17-22]
- Modern practices typically fit over 50% of their patients into either daily disposable or silicone hydrogel materials. To-date, little has been published comparing the dehydration rates of these two options.

Purpose

- The purpose of this study was to use an in vitro model to measure the rate of dehydration of 6 silicone hydrogel (SH) and 3 conventional polyHEMA-based daily disposable (DD) and frequent replacement (FR) hydrogel materials.

Materials & Methods

- The rate of water loss was assessed gravimetrically (Sartorius MA 100H; Figures 3&4) in a humidity controlled environment for a variety of materials of varying water content (WC).
- Three DD (etafilcon A; narafilcon A; nelfilcon A) and 6 FR (lotrafilcon A; lotrafilcon B; balafilcon A; galyfilcon A; senofilcon A; omafilcon A) hydrogel materials were continuously assessed for water loss over a 20 minute period of time.

Figure 3

Figure 4

Results

- For both DD and FR groups, the rate of water loss/minute was strongly correlated with initial WC (r>0.8).
- Within the DD group (Figure 1), the low WC SH material (narafilcon A) exhibited the slowest rate of dehydration (p<0.01). Within the FR group (Figure 2), the material with the lowest WC (the SH material lotrafilcon A) exhibited the least amount and slowest rate of dehydration (p<0.01) and the material with the highest water content (omafilcon A) exhibited the fastest rate of dehydration (p<0.05).
- There was no significant difference (p>0.05) in rate of water loss between the conventional material with the highest water content (omafilcon A; 62% WC) and the SH material with the highest water content (galyfilcon A; 47% WC).

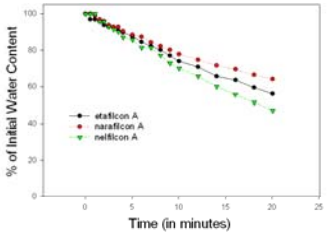

Figure 1: Dehydration rate of DD lenses

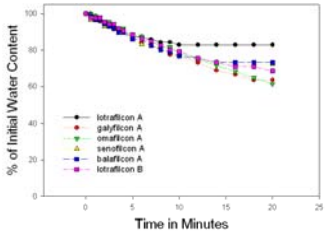

Figure 2: Dehydration rate of FR lenses

Conclusions

- Bulk dehydration rates for hydrogel materials are closely related to the initial water content of the material, as shown by this study and others.[9-11]
- Given the wide variety of comfort responses reported by subjects between materials of similar water content, it is unlikely that bulk dehydration is directly related to comfort, but that other factors such as surface hydration, surface wettability, lens design and modulus are more important in the comfort of hydrogels.
- Much work remains to unravel why lower water content materials tend to result in enhanced comfort scores.

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