Hybrid Contact Lenses for Daily Wear Orthokeratology

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Introduction
Orthokeratology (ortho-K) is a contact lens method primarily for myopia control, traditionally wearing a rigid gas permeable (RGP) lens while asleep, slowing eye growth up to 55%. However, there are issues with the current overnight RGP ortho-K lenses that must be addressed:
- Increased risk of microbial keratitis especially in children
- Reports of corneal ulcers leading to scarring and reduced best-corrected visual acuity
- Discomfort

The purpose of this study was to explore a novel method for orthokeratology using a comfortable hybrid lens modality in an open eye environment. The ultimate goal is to develop a lens that children can wear for 1 hour in the evening before going to sleep. To this date, no studies have been completed on hybrid ortho-K lenses.

Material and methods
Eight eyes of four healthy subjects 24-25 years old, all current soft contact lens wearers, were empirically fitted with the Chow 5.1 ortho-K lens design in the Eyebrid hybrid lens material (Caen, France) using OrthoTool (Figure 1). The Eybrid lens consists of a fluoro-silicone-acrylate RGP center (diameter 10.0mm, Dk 50, BC 8.9) and a silicone hydrogel soft skirt (total diameter 14.9mm, Dk 50, BC 8.9).

Subjects were instructed to wear the Eybrid lens for 4 hours while awake for 10 consecutive days, with pre- and post-lens wear testing occurring on Days 1 and 10. Baseline corneal topography was obtained on the Medmont E300 topographer.

Testing consisted of anterior segment OCT (Cirrus OCT, Zeiss) of the central 6mm, nasal, and temporal edges. Lens fit was assessed with high molecular weight hydrogel OCT (Medmont) as well as with anterior segment OCT (Cirrus OCT, Zeiss) of the central 6mm, nasal, and temporal edges. Testing consisted of anterior segment OCT (Cirrus OCT, Zeiss) of the central 6mm, nasal, and temporal edges. Lens fit was assessed with high molecular weight hydrogel OCT (Medmont) as well as with anterior segment OCT (Cirrus OCT, Zeiss) of the central 6mm, nasal, and temporal edges.

Results
The axial (Figure 2A) and tangential (Figure 2B) difference display maps on the Medmont Studio topographer software showed mean amount of corneal flattening was 2.09±1.92D with a mean treatment zone diameter of 1.98±1.01mm. 50% of lenses were decentered temporally and 37.5% were centered. 5 of the 8 eyes showed areas of mid-peripheral steepening, but of those 5, only 2 had complete mid-peripheral steepening 360 degrees.

Figure 2: Axial display (A) and tangential display (B) difference maps on Medmont Studio

Silt lamp assessment of the lens after 4 hours of wear showed punctate epithelial staining in the central cornea, ranging in diameter from 1-2mm, in at least one eye of all subjects (Figure 3). The staining was allgraded as Grade 2-3. Due to this unexpected adverse event, it was decided to discontinue lens wear for all subjects after one day.

Discussion
The amount of corneal flattening was comparable to data from the literature on overnight ortho-K lenses, and comfort with the Eybrid lens was rated as better than initial RGP comfort, showing hybrid ortho-K lenses can be successfully worn for a few hours in the open eye with similar results to the overnight modality. However, future studies are warranted to address the issues of the lack of mid-peripheral thickening for myopia control and presence of corneal epithelial punctate staining.

References