

## Introduction

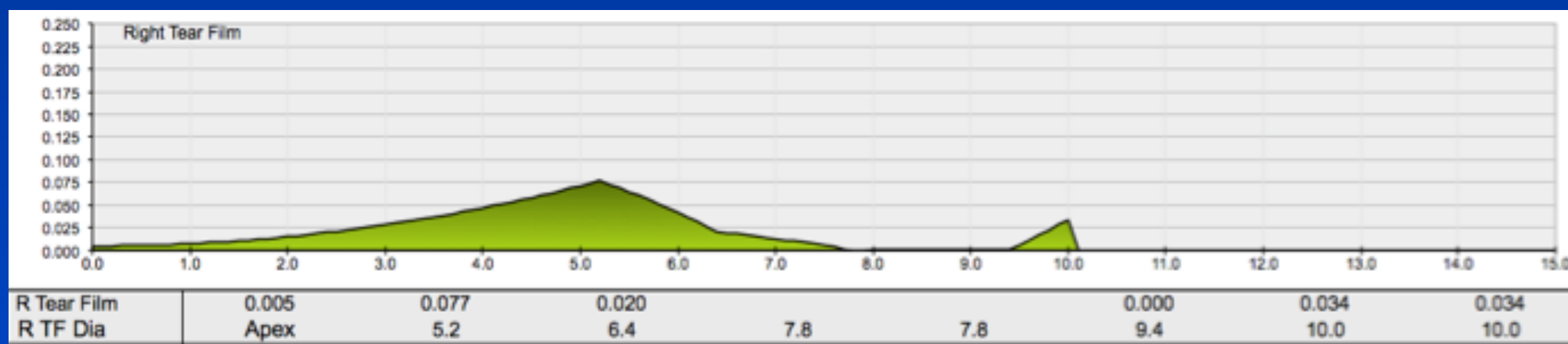
Orthokeratology (ortho-K) is a contact lens method primarily for myopia control, traditionally wearing a rigid gas permeable (RGP) lens while asleep, slowing eye growth up to 55%.<sup>1,2</sup> However, there are issues with the current overnight RGP ortho-K lenses that must be addressed:

- Increased risk of microbial keratitis especially in children<sup>3-6</sup>
- Reports of corneal ulcers leading to scarring and reduced best-corrected visual acuity<sup>7</sup>
- 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 lens ortho-K.

## 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 Eyebrid lens consists of a fluoro-silicone-acrylate RGP center (diameter 10.0mm, Dk 100) and a silicone hydrogel soft skirt (total diameter 14.9mm, Dk 50, BC 8.9).



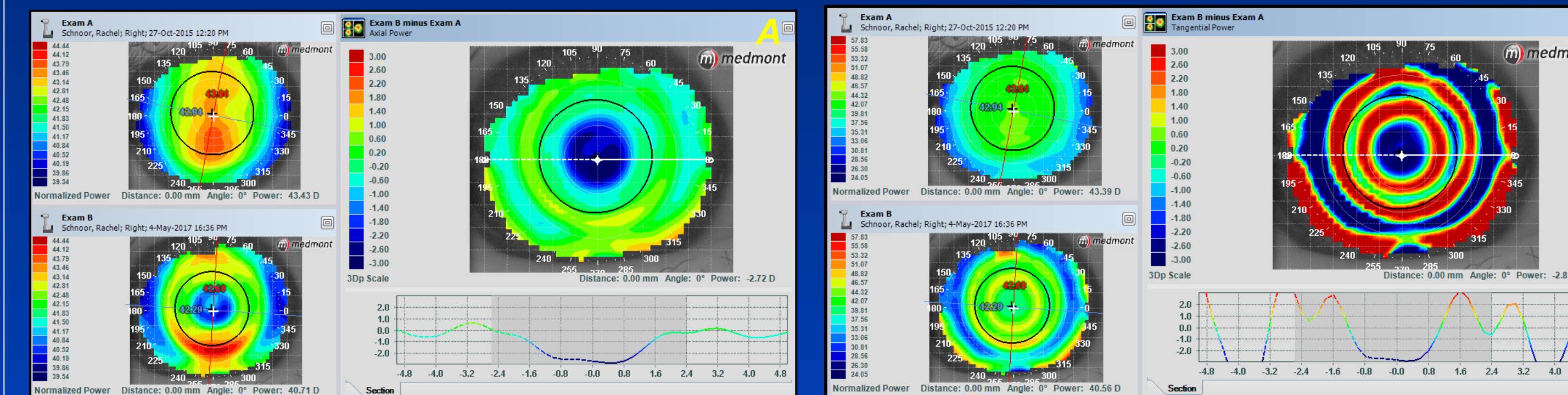
**Figure 1: Lens profile of the center RGP on OrthoTool (version 03.09.13)**

Subjects were instructed to wear the Eyebrid 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 sodium fluorescein under a slit lamp with cobalt blue lighting and a Wratten filter. After 4 hours of lens wear, corneal topography was repeated after lens removal. Subjects were also asked to subjectively rate the comfort of the lens in each eye on a scale from 0 (unable to tolerate) to 10 (perfect).

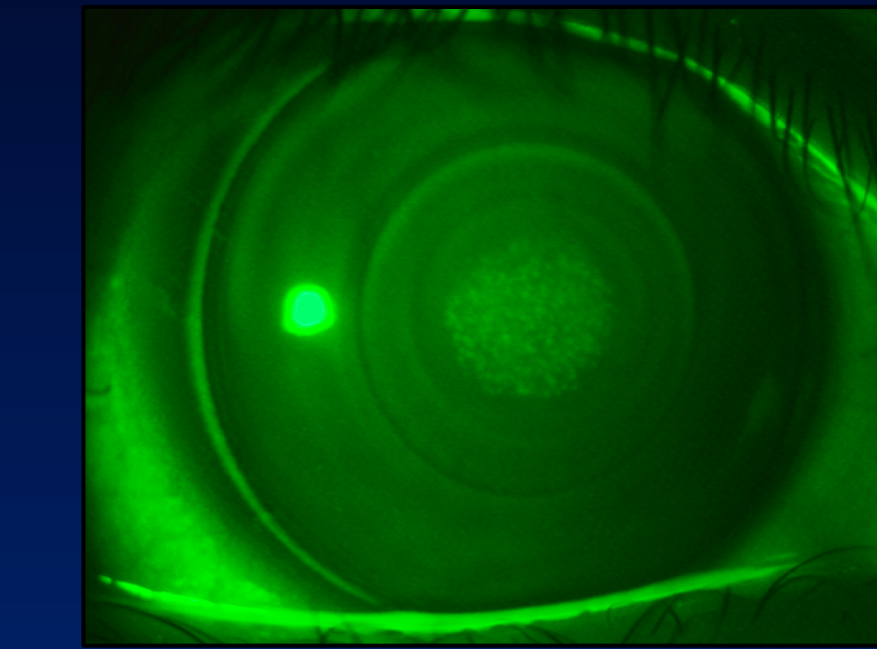
## Results

The axial (Figure 2A) and tangential (Figure 2B) difference display maps on the Medmont Studio topographer software showed mean amount of corneal flattening was  $2.09 \pm 1.02D$  with a mean treatment zone diameter of  $1.98 \pm 1.01mm$ . 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.

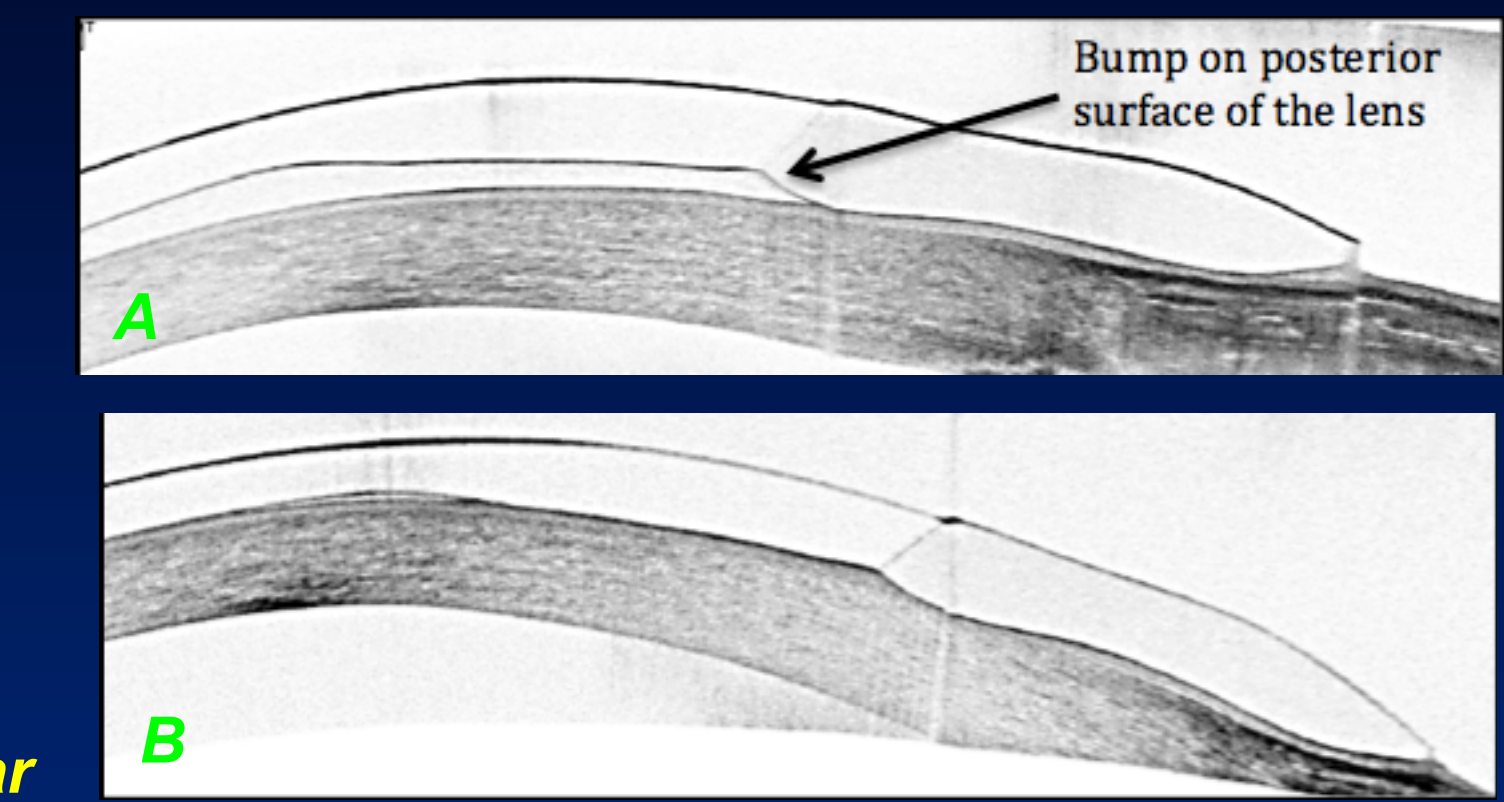


**Figure 2: Axial display (A) and tangential display (B) difference maps on Medmont Studio**

Slit 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 all subjectively rated as Grade 2-3. Due to this unexpected adverse event, it was decided to discontinue lens wear for all subjects after one day.



**Figure 3: Central punctate staining after 4 hours of lens wear**



**Figure 4: Lens dispense (A) and post-4 hour wear (B) showing lens settling**

On OCT, a bump on the posterior lens (part of the traditional Eyebrid lens design) that elevates the GP portion away from the cornea (Figure 4A). After 4 hours, the lens settles into the epithelium for the ortho-K effect to take place (Figure 4B). Subjects reported a mean comfort rating of  $7.25 \pm 0.7$ . All but one subject rated their comfort as symmetrical between the two eyes, regardless of the presence of epithelial staining.

## Discussion

The amount of corneal flattening was comparable to data from the literature on overnight ortho-K lenses, and comfort with the Eyebrid 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

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- <sup>2</sup>Walline J, Jones L, Sinnott L. Corneal reshaping and myopia progression. *Br J Ophthalmol* 2009; 93: 1181-1185.
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- <sup>4</sup>Van Meters WS, Musch DC, Jacobs DS, Kaufman SC, Reinhart WJ, Udell IJ. Safety of overnight orthokeratology for myopia. *Ophthalmology* 2008; 115: 2301-2313.
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- <sup>7</sup>Young AL, Leung ATS, Cheng LL, Law RWK, Wong AKK, Lam DSC. Orthokeratology lens-related corneal ulcers in children: A case series. *Ophthalmology* 2004; 111: 590-595.