

# Keeping things stable

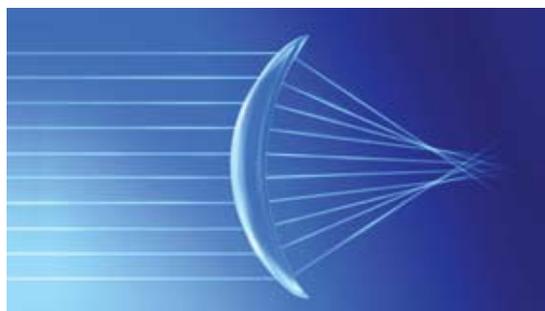
**Alexis Vogt** describes the features of a new silicone hydrogel toric lens

**T**hroughout the history of contact lens design the challenge of meeting the needs of astigmatic individuals has been significant. It is important to continue to strive to meet those needs when we consider the population that requires this correction. It has been reported that approximately 37 per cent to 45 per cent of adults have 0.75D or more of astigmatism.<sup>1-3</sup> With almost half of the population of contact lens wearers having significant astigmatism,<sup>2</sup> the contact lens industry as a whole must continue to support the needs of this large group of patients.

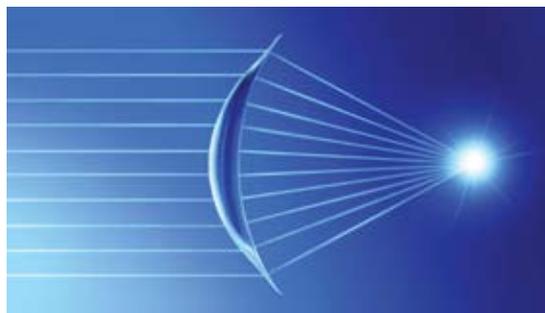
In a survey of 201 astigmatic contact lens wearers, the symptoms most often cited while wearing current toric lenses included regularly or occasionally experiencing blurry/hazy vision, fluctuating vision, and distorted vision.<sup>4</sup> Forty-seven per cent of subjects reported experiencing blurry or hazy vision, 37 per cent reported fluctuating vision, and 32 per cent reporting distorted vision. Additionally, 32 per cent of toric patients reported experiencing glare and halos in low-light conditions. Product benefits of toric lenses (in the categories of vision, comfort, health and convenience) were presented to patients randomly in successive groups of four for ranking. The benefit of highest relative importance for a toric soft contact lens was that it should 'deliver consistently sharp vision all day'. Attributes and performance of current toric lenses may limit the ability of patients to achieve consistently crisp, clear vision throughout the day. Patients are looking for contact lenses that offer uncompromised vision and stability without compromising comfort.

## Design attributes and clinical experience

Addressing the needs of astigmatic patients was the primary goal when Bausch+Lomb designed PureVision 2 For Astigmatism with High Definition Optics. Three lens design attributes



**Figure 1** A lens with spherical aberration has different focal points for the light rays passing through the centre and the periphery of the lens



**Figure 2** Bausch+Lomb lenses with high definition optics are designed to reduce the positive spherical aberration that is naturally occurring in the human eye and bring all of the light rays to the same focal point

have been incorporated to work together and achieve exceptional toric lens performance: High Definition Optics, Auto-Align Design, and ComfortMoist technology.

## High Definition Optics

Spherical aberration is the inability of the eye to focus light rays passing simultaneously through the centre and the periphery of the eye. The retinal image appears blurred because the peripheral light rays are focused anterior to the retina (Figure 1).

Spherical aberration can be a barrier to high-quality vision in low light, resulting in blurred vision, halos and glare. Bausch+Lomb lenses with High Definition Optics are designed to reduce the positive spherical aberration that is naturally occurring in the human eye to minimise halos and glare and bring all of the light rays to the same focal point to create clear, crisp vision all day – especially in low light (Figure 2).

A conventional spherical contact lens does not consistently control spherical aberration across the power

range. Spherical lens designs inherently demonstrate spherical aberration due to their highly curved spherical surfaces; negative spherical aberration for negative power lenses, and positive spherical aberration for positive power lenses, in proportion to their back vertex power. Aspheric Bausch+Lomb contact lenses with High Definition Optics are designed to reduce the inherent spherical aberration of the eye and reduce the spherical aberration induced by the contact lens on-eye.

PureVision 2 HD For Astigmatism was designed with High Definition Optics to reduce spherical aberration in both the sphere and cylinder meridians, in quarter dioptre steps across the power range, for clear, crisp vision all day – especially in low light. PureVision 2 HD For Astigmatism is the only silicone hydrogel toric soft contact lens that reduces spherical aberration on both the spherical and cylinder meridians of the lens. By controlling spherical aberration in both the sphere and cylinder meridians, PureVision 2 HD For Astigmatism corrects for not only astigmatism and spherical aberration, but also reduces secondary astigmatism.

## Auto-Align Design

The stability of a toric lens is governed by several forces. Those forces can be divided into static (which include surface tension of the tears, gravity, conformity of the lens, and lid pressure at the top and/or bottom of the lens) and dynamic forces (which include upper and lower eyelid movement and eye movement). To better understand how lenses behave on-eye, several experiments were undertaken to understand one of the main drivers of instability, blinking dynamics. Blinking is essential to maintenance of the ocular surface and occurs at a speed that is almost imperceptible. The main muscle drivers of the blink are the horizontally aligned orbicularis oculi and the more vertically aligned, levator palpebrae and Muller's muscles. To capture the motion of these muscles, a high speed camera, capable of recording 300 frames per second was employed. The results showed that, from initiation to completion of the natural blink, only one-tenth of a second passes. In that time the

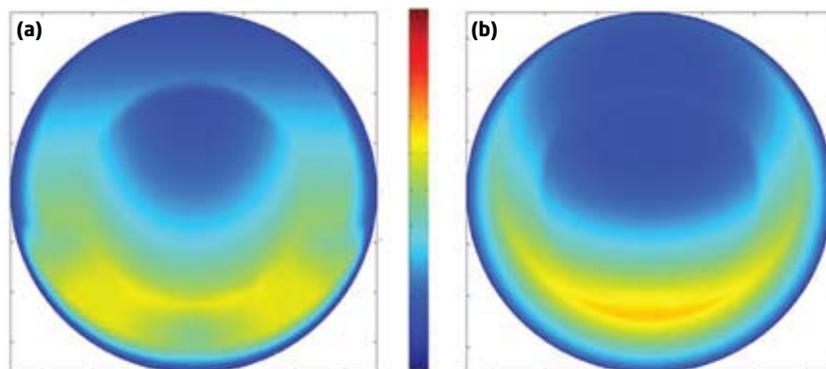


upper lid has travelled approximately 7.5mm down and 4.8mm nasal. Interestingly, the lower lid has limited vertical motion, leaving the upper lid to be almost entirely responsible for rewetting the ocular surface through the blink mechanics. Understanding these dynamics helps design a lens which can work with the dynamic range of the eyelids.

When the eyelids close during a complete blink, there is a slight downward displacement of the lens and the lids typically meet at a point 1-2mm from the base of the lens. For a lens to effectively leverage these blink dynamics and maintain stable orientation, the toric stabilising ballast should be designed with this in mind. By positioning the maximum ballast thickness low on the lens, the design can leverage the full motion of the upper lid while gaining support from the lower lid. Understanding eyelid movement during the blink and lens movement associated with eye and eyelid movement helped guide the development of the Auto-Align Design feature of PureVision 2 HD For Astigmatism. This feature allows the lens to achieve stability and orientation while providing consistently crisp, clear vision throughout the day.

Various innovative techniques have been employed to create a stable contact lens including truncation, dual slab-off, peri-ballast and prism ballast, to name a few, and there are multiple designs currently commercialised which are founded on these basic geometries. The new PureVision 2 HD For Astigmatism lens is founded on solid understanding of contact lens stability techniques. Sophisticated lens design software and innovative manufacturing techniques have allowed Bausch+Lomb to develop a lens that uses the best aspects of prism and peri-ballasting to create a hybrid ballasting system. The design provides excellent stability for consistent vision, with repeatable orientation even with the blink and eye movement. Manufacturing sophistication has also come of age and is carefully sculpting the contours of these lenses to blend with and work with the eye.

To improve centration, PureVision 2 HD For Astigmatism was designed with a larger diameter compared to PureVision Toric. PureVision 2 HD For Astigmatism was designed with a 14.5mm outer diameter and a base curve of 8.9mm. The larger diameter of PureVision 2 HD For Astigmatism offers more area to spread out the ballast design to reduce the maximum



**Figure 3** Thickness profiles of PureVision 2 HD For Astigmatism (a) and PureVision Toric (b), where the red indicates the thickest parts of the lens and the blue the thinnest

thickness compared to PureVision Toric (Figure 3). This helps create a more comfortable wearing experience, while maintaining the same large optic zone as PureVision Toric. The large optic zone (8.0mm for a -3.00-1.25x180 lens) also helps to reduce potential glare in low light conditions.

With optimised ballasting, a large lens diameter, and a large optic zone, PureVision 2 HD For Astigmatism minimises lens misrotation to help ensure outstanding stability and vision throughout the day.

### ComfortMoist Technology

ComfortMoist Technology has two key features: a thin lens design to provide a natural feel throughout the day and a moisture-rich packaging solution to provide excellent comfort upon insertion. PureVision 2 HD For Astigmatism continues to use a thin rounded edge design from PureVision 2 HD sphere, to enable a smooth, gentle transition of the lid from the lens to the conjunctival. The new lens design also features reduced lens markings, providing a more continuously smooth surface.

### Clinical findings

In a study evaluating the orientation characteristics and vision performance of PureVision Toric, an established balafilcon A toric design, and PureVision 2 HD For Astigmatism, with advanced aspheric optics, 20 investigators enrolled subjects into a multi-site cross-over study.<sup>5</sup> A total of 292 subjects completed the two-week study. Lens orientation measures indicated there was a greater proportion of eyes with  $<10^\circ$  rotation from the 6 o'clock position for PureVision 2 HD For Astigmatism at both the dispensing visit and the two-week follow up visit ( $p < 0.05$  for both). Over all visits, there were no significant differences between the lenses for movement. However, the PureVision 2 HD For Astigmatism

had a greater proportion of 'Excellent' ratings for centration ( $p < 0.05$ ). Visual acuity was excellent with the PureVision 2 HD For Astigmatism lens. Subject preference favoured PureVision 2 HD For Astigmatism 2:1 over PureVision Toric for vision characteristics, clear vision throughout the day, stable and consistent vision throughout the day, clear vision in low light, clear night vision, and do not see glare/halos with lenses ( $p < 0.001$ ).

### Conclusion

Vision and optical expertise remain fundamental in the development of new contact lens designs. Patients are looking for contact lenses that offer stable and consistent vision throughout the day without compromising comfort. The lens design of PureVision 2 HD For Astigmatism combines High Definition Optics, Auto-Align Design, and ComfortMoist Technology to provide the clear, crisp vision all day without compromising comfort that patients desire. ●

### References

- 1 Attebo K, Ivers RQ, Mitchell P. Refractive errors in an older population: the Blue Mountains Eye Study. *Ophthalmology*, Jun 1999;106(6):1066-1072.
- 2 Holden BA. The principles and practice of correcting astigmatism with soft contact lenses. *Aust J Optom*, 1975;58:279-299.
- 3 Katz J, Tielsch JM, Sommer A. Prevalence and risk factors for refractive errors in an adult inner city population. *Invest Ophthalmol Vis Sci*, Feb 1997;38(2):334-340.
- 4 Consumer Toric Needs Study: US. Millward Brown. December 2010.
- 5 Reindel WT, Cairns G, Liranso T. Improving vision performance for astigmatic patients through lens design. *Optom Vis Sci*, 2011;88:E-abstract 115803.

● **Alexis Vogt** is an optical physicist and manager medical affairs for Bausch+Lomb, Rochester