Silicone hydrogel CLs for astigmatism

Dr Neil A Pence and **Dr Tiffany M Andrzejewski** look at the design options for silicone hydrogel toric contact lenses and provide some fitting tips. **Module C19184, one specialist CET point for CLOs, one general CET point for optometrists and DOs**

Toric hydrogel contact lenses have been in the market for over 35 years, while their silicone hydrogel (SiH) counterparts have been around for less than a third of that. In the early days of SiH astigmatic contact lenses, patients who chose to sleep overnight in their lenses, those who showed clinical signs of hypoxia, or patients who required thicker lens profiles were the primary candidates to be switched from their previous hydrogel lenses.

Today, silicone hydrogel material has become the standard of care for astigmatic patients wearing soft contact lenses.[1]

SiH toric availability

Power parameters available for toric SiH lenses are extensive and continue to be expanded even further over time, allowing a large number of patients to enjoy freedom from spectacles. The options today are remarkably stable and predictable in their fitting characteristics. It is rare to be unable to successfully fit a patient whose correction falls within the available parameters. There are seven toric SiH options available from the major contact lens companies. The various SiH lenses differ not only in material and water content, but also in optics and design. Table 1 (page 24) summarises the parameters of these options.

Custom silicone hydrogel toric contact lenses are also available in the Definitive material from Contamac. Definitive is a 74 per cent water content latheable SiH material with a Dk of 60. It has been available in Europe for a number of years.

Stabilisation methods

To effectively neutralise astigmatic refractive error, a toric lens needs to align its cylinder axis with the axis of the astigmatic error. Different stabilisation designs keep the cylinder axis aligned on the eye. Some of these design features include prism ballast, thin zones (also known as double slab-off), posterior toric, chamfering, truncation, and combinations that incorporate different design features into a single lens.[2]

The Air Optix for Astigmatism (Alcon), Biofinity Toric (CooperVision), Avaira Toric (CooperVision), PureVision Toric (B+L), PureVision 2 HD for Astigmatism (B+L), Clariti toric (Sauflon) and Clariti 1 day toric (Sauflon) contact lenses are all stabilised with a variation of a prism-ballasted design. Prism-ballasted lens designs incorporate base-down prism into the contact lens.

Figure 1 Air Optix for Astigmatism, Precision Balance 8|4 Design

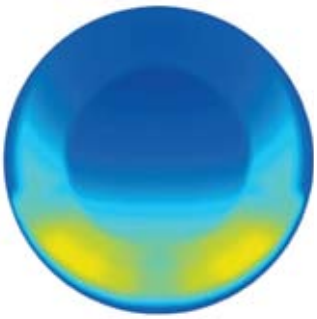

Figure 2 Auto-Align Design of the PureVision 2 HD for Astigmatism lens

Figure 3 Accelerated Stabilisation Design of the Acuvue Oasys and Advance for Astigmatism lenses

It is probably safe to say all prism-ballasted lenses employ some degree of thinning of the inferior portion of the lens, to allow greater comfort as it interacts with the lower lid. Thus the top portion of the lens is thin by virtue of being at the top of the 'prism', and the lower portion is thinned with a comfort chamfer of some sort, leaving the middle to slightly below centre as the thickest portion of the lens. It is easy to think of these lenses being oriented by the thick portion falling downward due to gravity, but it is much more probable that lid forces and blinking are the driving factors in stabilisation of the lens. The resultant lid forces squeeze out the thicker portion of the lens, causing it to align or be held between the lids,

The Air Optix for Astigmatism utilises CIBA's 'Precision Balance 8|4 Design,' incorporates a wide optic zone with a ballasting system that has the thickest portions of the lens located at 8 o'clock and 4 o'clock to assist with stabilisation (Figure 1). This varies from traditional prism ballast in that the 6 o'clock portion of the lens is significantly thinned.

The Biofinity Toric and Avaira Toric incorporate CooperVision's 'Optimised Ballast Design', which has a junctionless, wide ballast area encircling the optic zone and a constant horizontal thickness to maximise stability and reduce rotation during blinking. In CooperVision's design, the toric's ballast is designed to remain constant across all powers to result in predictable and consistent performance despite the lens power. This appears to be an optimised version of the ballast design used in the Biomedics Toric hydrogel contact lens.

The PureVision Toric from B+L uses a 'Lo-Torque Design' that is similar to the company's SofLens Toric. B+L has balanced the thickness of the mid-periphery with a 360-degree chamfer to reduce the lens mass in an otherwise standard prism-ballasted design.

The PureVision 2 HD for Astigmatism lens from B+L, while manufactured in the same material, features a number of changes compared to the original PureVision Toric design. In what is termed the 'Auto-Align' design, the lens mass has been reduced through a hybrid prism and peri-ballast design for stabilisation (Figure 2). Additionally, the lens diameter has been increased to 14.5mm (with a large optic zone of 8.0mm) to also help improve lens stabilisation.

Other features of the new PureVision 2 HD for Astigmatism include an enhanced correction of spherical aberration which addresses

spherical aberration reduction in both the spherical and cylinder meridians of the lens. This may allow reduced halos and glare, especially in low light conditions. The lens also has a thinner overall thickness profile, thus increasing oxygen transmission compared to the original PureVision Toric, has a thinner reshaped edge profile, and incorporates a wetting agent (poloxamine) in the package to help improve wetting and comfort at application.

Unlike the other SiH toric lens options, the Acuvue Oasys for Astigmatism (Vistakon) and Acuvue Advance for Astigmatism (Vistakon) designs both feature an 'Accelerated Stabilisation Design' rather than relying on prism ballasting for orientation and stability. Vistakon incorporated four active zones of added thickness located in the mid-periphery of the lens and a dual thin zone superiorly and inferiorly (Figure 3). The thin zones rest under the open eyelid, and thick zones rest within the open eyelid. The lens is designed to be actively rotated into place upon blinking whenever it is misoriented and then held stable when the lens is correctly aligned. Consequently, it may more quickly rotate into position and remain stable during wear. The second generation Acuvue Oasys for Astigmatism seems to employ a slightly more enhanced version of this stabilisation technique.

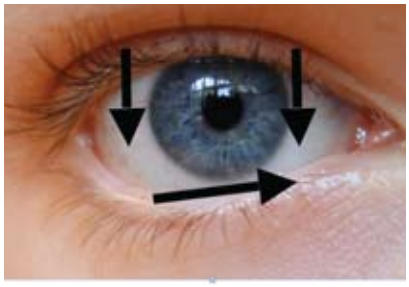

Figure 4 Conflicting actions of the upper and lower eyelid during blinking

Lens stability and direction of rotation

If the lens cylinder correction is misaligned, or aligned but swings off-axis during a blink, then a patient's vision will be compromised. It is this lack of consistency in rotational position and stability that is often the primary reason for patient success or failure with toric soft contact lenses.[3]

Both the upper and lower lids influence orientation of a toric soft lens. However, because the lids move in nearly perpendicular directions, they can influence orientation in different ways (Figure 4). In most cases, the downward force of the upper lid acts on asymmetric lens thickness profiles to force the lens into place.[4] Thus, variability has been found in the amount and direction of rotation among toric soft lens wearers due to factors such as eyelid anatomy, the thickness profile of the lens, and the fitting relationship between the lens and the eye.[5]

More recent studies have led to a better understanding of how patient and lens factors influence lens fit. The lid position, the upward or downward slope of the lids, and palpebral fissure size are all factors affecting lens orientation and stability.[6] Due to all of these extraneous factors, it is difficult to guarantee that all toric lenses will orient at the zero position, and contrary to the popular belief that the lenses will always rotate nasally,[5] a high proportion may rotate temporally, too. Most silicone hydrogel toric soft lenses will rotate within 5-10 degrees of the zero position. However, because different lenses have different designs and interact with the lids in different ways, we cannot expect nor predict that each design will perform and orient to the same position on a given eye without the application of diagnostic lenses.

Clinicians at Indiana University have ▶

observed the rotational characteristics for several silicone hydrogel toric lens designs (Acuvue Oasys for Astigmatism, Acuvue Advance for Astigmatism, Biofinity Toric, Air Optix for Astigmatism, and PureVision Toric) to analyse their performance based on a records review of lenses ordered and dispensed in which some rotation was noted.[6] These studies showed that, in general, all five lenses demonstrated very little rotation in most patients, exhibiting either no or a relatively small amount of rotation in all cases. Particularly, in more than 95 per cent of eyes fit in any of the studied designs, the lenses rotated 10 degrees or less. More than 80 per cent were within 5 degrees of zero.

However, when rotation was present, Acuvue Advance for Astigmatism and Biofinity Toric exhibited a slight tendency to rotate nasally, while Air Optix for Astigmatism, PureVision Toric, and Acuvue Oasys for Astigmatism showed a slight tendency to rotate temporally. Understanding these tendencies and the fact that these designs overall are quite stable may help reduce chair time during the fitting process. While experience is limited with the PureVision 2 HD for Astigmatism contact lens, it clearly shows a tendency for a much lower amount of temporal rotation than the original PureVision Toric

Lens markings on astigmatic SiH contact lenses

All astigmatic contact lenses will have lens markings to indicate the lens orientation. Acuvue Oasys for Astigmatism and Acuvue Advance for Astigmatism have single scribe marks at 6 and 12 o'clock. The Clariti toric and Clariti one day toric have a marking at 6 o'clock as do the Biofinity and Avaira Torics. The PureVision Toric has three laser lines at 5, 6, and 7 o'clock (30 degrees apart). The Air Optix for Astigmatism lens has marks at 3, 6, and 9 o'clock, with the mark at 6 o'clock being thicker than the other two. For an example of a -2.00 – 0.75 x 180 lens, at the roughly 12 o'clock position will be the labelling 'CIBA ▶

TABLE 1

Current toric silicone hydrogel parameters

Lens	Dk	Water content	Base curve/ diameter (mm)	Sphere power (D)	Cylinder power (D)	Axis
Purevision Toric	91	36%	8.7/14.0	+6.00 to -9.00	-0.75, -1.25, -1.75, -2.25	0-180° (10° steps)
Purevision 2HD for Astigmatism	91	36%	8.9/14.5	Plano to -6.00	-0.75,-1.25,-1.75	0-180° (10° steps)
Air Optix for Astigmatism	110	33%	8.7/14.5	+6.00 to -10.00	-0.75, -1.25, -1.75, -2.25	0-180° (10° steps)
Avaira Toric	100	46%	8.5/14.5	Plano to -6.00	-0.75,-1.25,-1.75	0-180° (10° steps)
Biofinity Toric	128	48%	8.7/14.5	+8.00 to -10.00	-0.75, -1.25, -1.75, -2.25	0-180° (10° steps)
Acuvue Oasys for Astigmatism	103	48%	8.6/14.5	Plano to -6.00	-0.75, -1.25, -1.75	0-180° (10° steps)
					-2.25	10,20,70,80,90,100,110, 160,170,180°
				-6.50 to -9.00	-0.75, -1.25, -1.75	0-180° (10° steps)
				+0.25 to +6.00	-0.75, -1.25, -1.75	10,20,70,80,90,100,110, 160,170,180°
					-2.25	10,20,90,160,170, 180°
Acuvue Advance for Astigmatism	60	38%	8.6/14.5	Plano to -6.00	0.75, -1.25, -1.75	0-180° (10° steps)
					-2.25	10,20,70,80,90,100,110, 160,170,180°
				-6.50 to -9.00	-1.25, -1.75	10,20,70,80,90,100,110, 160,170,180°
					-2.25	10,20,90,160,170, 180°
				+0.25 to +6.00	-0.75, -1.25, -1.75	10,20,160,170,180,70,8 0,90,100,110°
Clariti toric	60	56%	8.7/14.4	+6.00 to -9.00	-0.75, -1.25, -1.75, -2.25	0-180° (10° steps)
Clariti 1 day toric	60	56%	8.6/14.3	Plano to -8.00	-0.75, -1.25	20,70,90,110,160,180°
Note: Clariti 1 day toric soon to be expanded into plus powers						

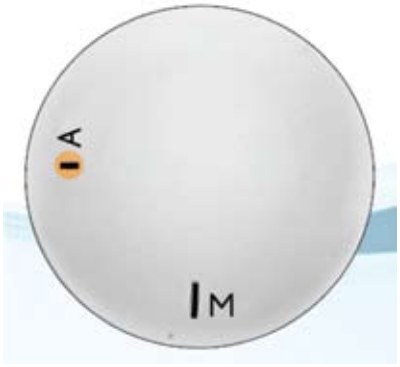

Figure 5 PureVision 2 HD for Astigmatism lens markings example

B749'. The 'B' designates the Air Optix for Astigmatism design (an 'X' is used to denote the Air Optix Aqua sphere lens). While perhaps not correct all of the time and not confirmed by the manufacturer, we have seen that the nomogram '53 is -3' is fairly accurate. This number goes up 1 for each 0.25D steps higher in minus, (a -3.25 would be '54), and goes down 1 for each 0.25D step lower in minus (-2.75 is '52'). Thus in the example here, a '49' is four steps lower than a -3.00D, so is a -2.00D sphere power.

The newest B+L SiH toric contact lens introduction, the PureVison 2 HD for Astigmatism, has taken this labelling a step or two further. This lens has a single vertical mark at 6 o'clock, with a single capital letter beside it. This letter corresponds to the lens sphere power. Somewhere else on the lens will be a small single line mark, with another letter next to it. This smaller line will be oriented at the location of the lens axis. An example of these markings in shown in Figure 5.

With the help of a Lens Power Identifier chart (Figure 6), this second letter helps determine the exact sphere and cylinder power of the contact lens. For example, if the letter near 6 o'clock is 'M' the sphere power could be -2.25, -2.50, -2.75 or -3.00. If the second letter located in the top half of the lens is an 'A', finding the location where the 'M' and 'A' intersect identifies the sphere power as a -3.00. The 'A' also signifies a 0.75 cylinder power. Therefore, if the small line had been at 180, the exact lens power can be determined (-3.00 – 0.75 x 180).

The ability to identify the lens power from the markings on the lens is of course very useful for any patient that might be new to the practice. It is also very helpful for follow-up visits of patients wearing an astigmatic lens. Often two eyes will have similar prescriptions, maybe differing only slightly in either axis or cylinder power. If the patient had inadvertently switched lenses between eyes, it is not uncommon to spend a great deal of time figuring that out during a practice visit. Whenever possible, it is much easier to simply verify that the correctly marked lens is in each eye, and when not. The problem is generally solved by putting the lenses back into the correct eyes.

FITTING TIPS FOR TORIC LENSES

- Start with an up-to-date refraction. If the power in any meridian is >-4.00D, then vertex convert the powers for both meridians
- Choose the closest power to the spectacle refraction. If the exact prescription is not available:
  - Increase minus sphere power on pre-presbyopic myopes if the cylinder power is under-corrected
  - Do not over-correct the cylinder
  - Use the exact or the closest axis possible
- Allow the lens to settle, then check rotation and note the range
  - If necessary, compensate for the axis rotation by applying LARS (left-add, right-subtract) to the refractive cylinder axis
  - Keep in mind that the new contact lens should rotate the same amount as the original lens
- To assess stability, check orientation with blinking and version movements
  - Ask patients to look up and blink, look down and blink, and look in horizontal gaze
  - Look for lens lag without rotation
  - Sometimes it is valuable to use the lid to rotate the lens off-axis, then observe how quickly it returns to its original position with normal blinking
- Check the patient's acuity. Vision, at minimum, should equal spectacle lens visual acuity. Misorientation can explain most cases of poor visual acuity with toric lenses and can become more significant as the cylinder increases. This is why it is sometimes more efficient to check the fit and/or visual acuity before proceeding to performing an over-refraction. If the lens is stable and well-oriented yet vision is still reduced, perform a sphero-cylindrical over-refraction
- Dispense or order diagnostic lenses. If vision is adequate, dispense diagnostic lenses to the patient from your diagnostic kit or order diagnostic lenses based on your over-refraction. When determining lenses to order based on your over-refraction, several internet sites let you enter the soft toric diagnostic lens over-refraction data to obtain a suggested sphere, cylinder, and axis correction using resultant cross-cylinder calculations. Coopervision.com and eyedock.com are two such sites that provide this useful tool
- If a patient returns with a complaint of blurred vision:
  - If the blur is constant, focus on changing the lens power
  - If the blur fluctuates, consider the lens to be less stable than desired, and fit a different lens
  - When fitting a different lens seems warranted, consider fitting with a lens that has at least a somewhat different stabilisation method than the previous lens

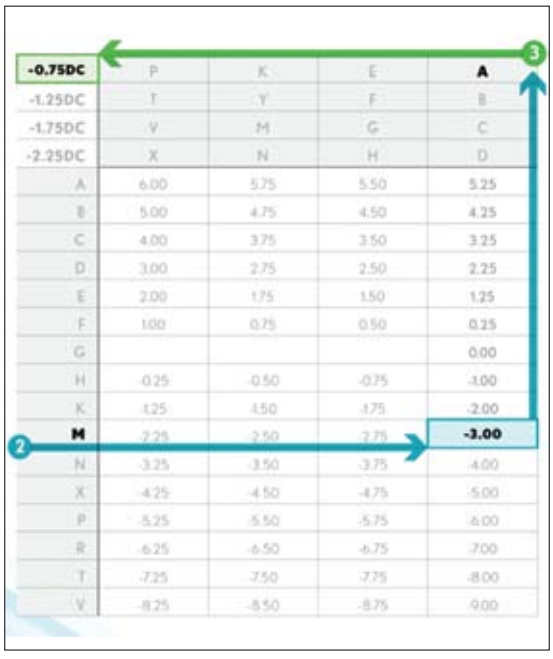

Figure 6 PureVision 2 HD for Astigmatism lens identification chart

When to correct astigmatism

Most toric fitting sets are available with 0.75D to 2.25D of cylinder in 0.50D steps (Table 1). However, there remains some disagreement as to when toric lenses are indicated. The recently published results of a 10-year survey pertaining to soft lens toric prescribing habits from seven countries indicated that refractive cylinder of 0.75D or less is not routinely being corrected with toric lenses.[7] Historically, a significant number of practitioners have ignored low levels of astigmatism, making the decision to fit patients with spherical ▶

or aspheric lenses in an attempt to fit simpler designs, increase lens comfort or stability of vision, or limit patient cost.

Despite the fact that it has been shown that 'masking of astigmatism' with spherical lenses is minimal[8] or non-existent, and that aspheric lenses are ineffective at correcting astigmatism as compared to soft toric designs,[9] the number of patients fitted with toric lenses still remains lower than it should be. With the ease of fitting and comfort to rival a spherical contact lens, and with the excellent stability and quality of the current SiH toric lenses, there seems to be little excuse for not giving even low astigmatic patients the improved quality of vision these lenses provide.

Individual practitioners may have different cut-offs for how much astigmatism to leave uncorrected. Naturally, this cut-off varies among patients depending on their refraction as well as their visual demands. There have been suggestions that highly myopic patients will tolerate uncorrected cylinder better, so there is less need to correct it in a contact lens. While there is a slight reduction in their corneal plane cylinder power compared to the spectacle cylinder power, once vertexed the effect of say 0.75 diopters of uncorrected astigmatism on the retinal image would be identical in a -8.00D patient or a -2.00D patient. A number of studies have confirmed that low-to-moderate astigmats (0.75DC to 1.25DC) have significantly better visual acuity with toric lenses than with spherical equivalent lenses.[10,11] Patients deserve and very often will appreciate the correction that allows them their very best vision.

Conclusion

Better lens reproducibility, more frequent replacement schedules, availability of expanded parameters, more oxygen-permeable and better wetting materials, and improved lens designs have all contributed to very high success rates when prescribing SiH torics. The health benefits, particularly the increased oxygen permeability, of SiH lenses are highly documented throughout the literature. Sufficient oxygen permeability often results in a healthy corneal environment, with minimal to no effects of hypoxia and an ability to combat common lens-related complications.[12] Newer toric lens designs tend to reduce lens rotation and provide excellent rotational stability for clear and stable vision.

Silicone hydrogel contact lenses for astigmatism are not only easy to fit and comfortable for our patients, due to lens design innovations, but they are a healthy option. They have very rapidly become the toric lenses of choice for both new and existing contact lens wearers who have astigmatism. With increased practitioner comfort in their use, the hope is that more and more patients will be offered the superior vision provided by these astigmatic contact lenses. ●

MULTIPLE-CHOICE QUESTIONS – take part at opticianonline.net

1 Which of the following lenses has an 'Auto Align' design?
A Air Optix for Astigmatism
B Biofinity Toric
C PureVision 2HD for Astigmatism
D Clariti 1 day toric

2 Which of the following lenses has an 'Optimised ballast' design?
A Air Optix for Astigmatism
B Biofinity Toric
C PureVision 2HD for Astigmatism
D Clariti 1 day toric

3 Which of the following lenses has the thickest portions of the ballasting system at 8 and 4 o'clock?
A Air Optix for Astigmatism
B Biofinity Toric
C PureVision 2HD for Astigmatism
D Clariti 1 day toric

4 Which of the following lenses incorporates 'Accelerated Stabilisation' design'?
A Air Optix for Astigmatism
B Biofinity Toric
C PureVision 2HD for Astigmatism
D Acuvue Oasys for Astigmatism

5 Most silicone hydrogel toric lenses will rotate within how much of the zero position?
A No rotation
B 5 to 10 degrees
C 15 to 20 degrees
D Uncontrollable rotation 'in eye'

6 Which of the following lenses includes a marking to indicate sphere power?
A Air Optix for Astigmatism
B Biofinity Toric
C PureVision 2HD for Astigmatism
D Clariti 1 day toric

Successful participation in this module counts as one credit towards the GOC CET scheme administered by Vantage and one towards the Association of Optometrists Ireland's scheme.
The deadline for responses is June 28 2012

References

1 Morgan PB, Woods CA, Jones D, *et al.* International contact lens prescribing in 2006. *Contact Lens Spectrum,* 2006;22:34-38.
2 Edrington TB. A literature review: the impact of rotational stabilisation methods on toric soft contact lens performance. *Cont Lens Anterior Eye,* 2011;34:104-110.
3 Goldsmith WA, Steel S. Rotational characteristics of toric contact lenses. *Int Contact Lens Clin,* 1991;18:227-230.
4 Young G, Hickson-Curran S. Reassessing toric soft lens fitting. *Contact Lens Spectrum* 2005:20:42-45.
5 Hanks AJ, Weisbarth RE. Troubleshooting soft toric contact lenses. *ICLC,* 1983;10:3015-3017.
6 Pence N, Doke-Borden C, Sellars S, Kovacich S. 'Rotational characteristics of Acuvue Oasys for Astigmatism contact lenses', American Academy of Optometry Annual Meeting Poster Presentation, Orlando, FL, 2009.
7 Young G, Hunt C, Covey M. Clinical evaluation of factors influencing toric soft contact lens fit. *Optom Vis Sci,* 2002;79:111-119.
8 Young G, McIlraith R, Hunt C. Clinical evaluation of factors affecting soft toric lens orientation. *Optom Vis Sci,* 2009;86(11):E1259-E1266.
9 Morgan PB, Efron SE, Hill EA. Inefficacy of aspheric soft contact lenses for the correction of low levels of astigmatism. *Optom Vis Sci,* 2005;82;9:823-828.
10 Richdale K, Berntsten DA, Mack CJ, Merchea MM, Barr JT. Visual acuity with spherical and toric soft contact lenses in low- to moderate-astigmatic eyes. *Optom Vis Sci,* 2007;84:969-975.
11 Dabkowski JA, Roach MP, Begley CG. Soft toric versus spherical contact lenses in myopes with low astigmatism. *Int Contact Lens Clin,* 1992;19:252-256.
12 Fonn D, Dumbleton K, Jalbert I, Sivak A. Benefits of silicone hydrogel lenses. *Contact Lens Spectrum,* 2006. Available at: www.clspectrum.com/article.aspx?article=12955. (Accessed May 16, 2011).

● **Dr Neil A Pence** is a member of the faculty of Indiana University School of Optometry in Bloomington, Indiana where he serves as the Associate Dean for Clinical and Patient Care Services. **Dr Tiffany Andrzejewski** is a 2010 graduate of the Illinois College of Optometry