Masking irregular corneal graft astigmatism with silicone hydrogel contact lenses

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Case report
A 29-year-old male patient (TH) was referred to the author for contact lens fitting in 2010. History revealed the patient to have had penetrating keratoplasty performed on his right eye approximately seven years earlier due to advanced keratoconus. TH was currently wearing a rigid gas permeable (RGP) contact lens on his left eye for the same condition (advanced keratoconus). An RGP lens had been worn on the right eye prior to the corneal graft surgery, however rigid contact lens wear on this eye after the transplant had been problematic, with the patient experiencing a number of graft rejection episodes most likely caused by contact lens-related corneal abrasions. TH stated that he had a very active lifestyle – including being an avid cyclist, swimmer and runner – and so he was very keen to optimize the vision in his right eye.

Slit-lamp examination of the right eye revealed a central, full-thickness corneal graft measuring about 8.0 mm in diameter. The graft was moderately proud, but clear centrally with minimal haze at the host-graft interface. Videokeratoscopy with the Medmont E300 Corneal topographer revealed the graft to have a significant degree of irregular astigmatism (Figure 1), which is not uncommon after corneal graft surgery.1,2

Figure 1  Topographical maps of the patient's right and left cornea.
Masking irregular corneal graft astigmatism with SiHy contact lenses – Jessica Chi

Spectacle refraction of R -0.50/-1.75 x 75 gave visual acuity of R 6/9. Slit-lamp examination of the left eye revealed advanced keratoconus evidenced by marked corneal thinning and early apical scarring. With his RGP lens, TH was able to obtain visual acuity of L 6/9 and the fit of this lens was deemed to be optimal.

Given the past history of problems post-graft with rigid contact lenses in the right eye, TH was averse to being refitted with a RGP lens for this eye. Although his spectacle acuity was quite good, TH rarely wore spectacles and was not keen to do so due to his active lifestyle. Consequently – based on the reasonable spectacle acuity – it was decided to fit the patient’s right eye with a disposable silicone hydrogel contact lens.

Numerous silicone hydrogel contact lenses were trialled on the right eye during the fitting process. Many of these lenses were an unsatisfactory fit, exhibiting marked lens fluting as a result of the proud graft. The best result was obtained with a PureVision® (Bausch & Lomb) lens in a steeper (8.3 mm) base curve. This lens fluted minimally at 3 o’clock upon insertion but quickly settled after a few seconds. Interestingly, this lens seemed to mask most of the graft astigmatism such that the over-refraction was relatively spherical. The final contact lens prescription was R 8.3/14.0/-2.00 and this gave visual acuity of R 6/6++. ReNu® Multi-Purpose Solution (Bausch & Lomb) was prescribed for lens maintenance.

Initially no problems were noted with the silicone hydrogel lens on the right eye. Vision and comfort with the lens were both excellent and TH very much appreciated now having good binocular vision. However, at the three week after-care visit, vision with the lens was now only R 6/6- and slit-lamp examination revealed both marked protein and lipid deposition on the lens, in the appearance of jelly bumps. No corneal staining was noted in the right eye, the graft looked healthy and the eye was white and clear. In view of the excessive lens deposition, TH was switched over to a hydrogen peroxide system (AOSept® Plus, CIBAVision) for lens maintenance. This reduced the problems with lens deposition at subsequent follow-up. The patient is currently wearing the lens on a full-time daily wear basis – with a monthly lens replacement schedule – and the contact lens acuity remains at 6/6++ for the life of each lens.

Discussion
Oxygen transmissibility (Dk/t) is a key factor when selecting contact lenses for post-graft fitting. Contact lenses which do not allow adequate oxygen to the cornea can result in an inflammatory or hypoxic disruption of the corneal immune system, and may give rise to
corneal neovascularisation. Corneal neovascularisation increases the risk of allograft rejection, which is the leading cause of graft failure in corneal transplants.\textsuperscript{3,4} Hypoxia will also lead to corneal endothelium decompensation which may also lead to graft failure.\textsuperscript{3,4} Consequently, it is essential to use lenses with a high Dk/t for post-graft fitting.

Figure 2 Example of a clear graft following successful penetrating keratoplasty (not this case)

Silicone hydrogel (SiHy) lenses are the preferred soft lens modality for post-graft fitting as they have a much higher oxygen transmissibility than hydrogel lenses due to the incorporation of silicone into the lens material.\textsuperscript{5} The silicone component in the SiHy polymer also leads to a greater lens modulus – rendering the lens ‘stiffer.’ The greater modulus may make it more difficult for the soft contact lenses to properly ‘drape’ over the donor cornea, and can lead to lens fluting (which occurred with many of the commercially available SiHy lenses that we tried fitting to TH). Thus, more accurate fitting is often required with SiHy lenses, and this is reflected in the contact lens market with the development of extra back optic zone radii (BOZR) for some of the commercially available SiHy lenses. We now even have the Custom Air Optix\textregistered from CIBA Vision that comes in four different BOZR for each of the three available lens diameters.
There are presently three generations of SiHy lenses – with the second and third generation lenses having significantly lower lens moduli compared to the first generation – due mainly to a decrease in the relative amount of silicone that is incorporated into the lens. The first generation of SiHy lens materials – balafilcon A (PureVision®, Bausch & Lomb) and lotrafilcon A (Night & Day®, CIBA Vision) – have moduli of 1.1 and 1.4 MPa respectively. The following generations of silicone hydrogel lenses exhibit a decrease in lens modulus; the second generation lens material senofilcon A (Acuvue Oasys®, Johnson & Johnson) has a modulus of 0.73 MPa, and the third generation lens materials comfilcon A (Biofinity®, CooperVision) and enfilcon A (Avaira®, CooperVision) have lens moduli of 0.75 MPa and 0.50 MPa respectively.

Greater lens modulus can increase the risk of contact lens papillary conjunctivitis and superior arcuate epithelial lesions, and can also lead to reduced lens comfort due to more mechanical irritation on the cornea and eyelids. However, in this case, using a lens with a greater lens modulus was definitely to our advantage. It was expected that TH would require a rigid contact lens to achieve the best possible acuity, given his irregular astigmatism and reduced spectacle acuity. Given TH had significant spectacle astigmatism, it was anticipated that a soft toric contact lens would be required to provide similar acuity to that obtained with spectacle correction. For TH, the greater modulus of the PureVision® lens meant that the lens was able to mask a significant amount of the irregular astigmatism, so that only a spherical lens design was required and the patient actually achieved better visual acuity with the soft spherical lens than he did with the full astigmatic spectacle correction.

This unusual refractive effect is not generally seen in routine contact lens practice, however it has been noted previously when fitting irregular or distorted corneas with silicone hydrogel contact lenses. Clinical experience has shown that for post-graft fitting, a spectacle prescription does not necessarily equate to the same back vertex power in a soft lens over a graft, particularly when high modulus lens materials are used in fitting. This refractive effect is also very fortunate, as clinical experience has shown that if a spherical soft disposable contact lens demonstrates lens fluting when placed on a corneal graft, then the toric equivalent is also likely to flute. Lens fluting will cause discomfort, corneal exposure, and unstable vision, especially for toric lenses.

The silicone in the silicone hydrogel polymer also leads to problems with surface wettability, rendering the lenses relatively hydrophobic, as compared to hydrogel lenses. Hydrophobic lenses are far more prone to deposition, particularly with lipids. Lipid deposition may
manifest on the lens as a heavy film across the surface of the lens, and in some cases may form lens calculi, also known as 'jelly bumps.' When this is the case, it is important to instruct the patient to be diligent with their lens care routine; patients must rub their lens, and – in some cases – a surfactant cleaner may be required.\textsuperscript{10} Due to the relative inaccessibility of surfactant cleaners in Australia, the patient was prescribed a hydrogen peroxide system that included rub and rinse in the lens care regimen.

References