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Two Cases of Post-Penetrating Keratoplasty Lens Fitting

BY COSTAS F. KATSOULOS, NICK H. VASILEIOU, LEFTERIS S. KARAGEORGIADIS, OD, & THEODORE T. MOUSAFIROPOULOS, OD

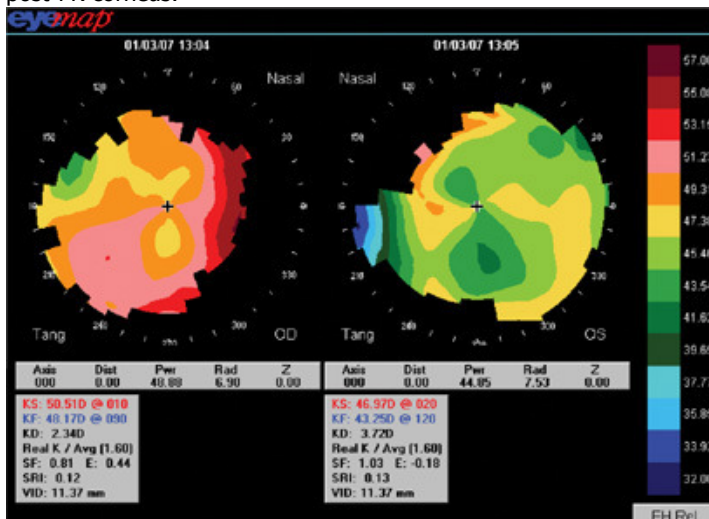
Fitting corneal transplants is not an easy task. We're often faced with extreme variations of curvature in various areas of the cornea. Part of the graft may be highly elevated, depending on the tension of the sutures and the eventual removal of some sutures. This can result in a tilted graft, which can complicate the fitting procedure.

Sometimes you'll find high amounts of astigmatism, usually against-the-rule and asymmetric. This lack of symmetry results in large amounts of coma, which is a higher-order aberration that can't be corrected with spectacle lenses and can be only partially masked with hydrogel lenses. GP lenses are highly indicated, as the tear film between the lens and the cornea can optically neutralize much of the coma depending upon the lens power; however, achieving adequate stability, movement and centration is not an easy task, especially if extreme elevation is present.

Here we will study two very different post-penetrating keratoplasty cases. The first patient presented with fairly regular postsurgical corneas for which we fitted standard aspheric bicurve GP lenses. The second patient presented with extreme corneal irregularity and required custom reverse geometry hydrogel lenses.

A Simpler Case

Patient #1 is a 23-year-old male who underwent penetrating keratoplasty on both eyes due to advanced keratoconus. Figure 1 shows the topographies of both corneas, which showed relatively little irregularity considering that they were post-PK corneas.



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Figure 1. Corneal topography of left eye (left) and of the right eye (right) for Patient #1.

Fitting for both eyes was straightforward. We used Beta AS lenses, which are standard aspheric bicurve GP lenses from Eyeart Laboratories (www.eyear.org), the first contact lens manufacturing company in Greece. The final contact lenses were OD 7.20mm base curve radius at 8.30mm optical zone, second curve 7.80mm radius out to the 9.80mm overall diameter, power -8.00D, VA 20/32 and OS 7.60mm:8.30mm/8.20mm: 9.80mm, power -5.00D, VA 20/30.

Due to lid sensitivity, we ordered these lenses in the hybrid Harmony material from Vista Optics (www.vista-optics.com), which has an 8mm GP center and an outer hydrogel skirt. This solved the lens edge awareness problems.

A More Complex Case

Patient #2 is a 27-yearold male who underwent penetrating keratoplasty on both eyes due to keratoconus (Figure 2). Figure 3 shows his corneal topography. Simulated keratometry readings indicated astigmatism of about 5.00D. The topography shows wide variations in corneal curvature; there are areas with corneal power of about 40.00 diopters and others where corneal power exceeds 100 diopters, as you can see in Figure 3. This difference is the cause, as you might imagine, of very poor unaided vision. When examined from the side, the look of the corneas resembled keratoglobus (Figure 4).

During diagnostic fitting we applied many GP lenses and even attempted reverse geometry designs to improve lens stability, but all would literally fall from the cornea after a while. We then decided to design and fit custom hydrogel reverse geometry lenses with increased thickness in an attempt to stabilize the lenses on the corneas and mask the corneal irregularity.

The first such lens that we designed for the right eye was tricurve with a second reverse curve and a third flattened curve. During wear, this lens resulted in the formation of a large bubble under its lower corneal portion. It was also almost totally supported by the lower lid, and if we pulled down the lower lid, the lens dropped down 3mm to 4mm.

To improve stability and make the lens drape more to the cornea, we progressively steepened the reverse curve and decreased the flattening of the third curve. The final diagnostic hydrogel contact lens OD had the following parameters: 8.20mm base curve at 9.50mm optical zone diameter, second curve 7.50mm radius up to 10.50mm diameter and third curve 8.35mm up to 14.50mm diameter, central thickness 0.32mm. This lens was designed and manufactured by Eyeart Laboratories in a 49-percent-water hydrogel material from Contamac.

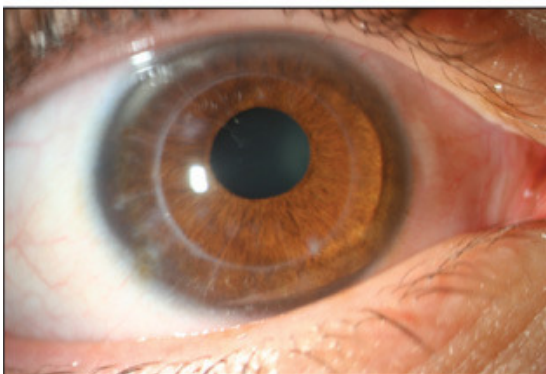
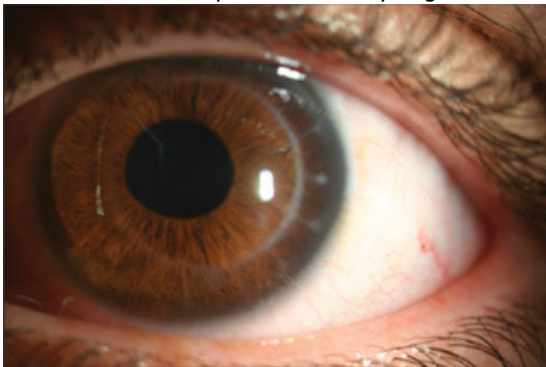


Figure 2: Patient #2, left eye (top) and right eye (bottom). The transplants are evident.

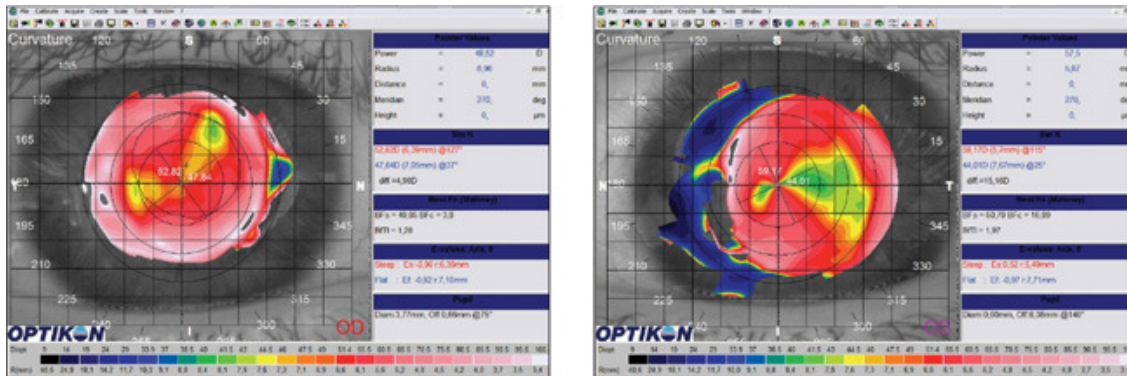


Figure 3: The corneal irregularity for Patient #2 is evident from these images. There are areas where the curvature reaches 100.00 diopters, and other areas where the curvature is around 40.00 diopters.

As you can see, the second reverse curve is a full 0.7mm steeper than the first, and the third flattened curve is only 0.15mm flatter than the first. With a power of $-6.00D$ (based on over-refraction) this eye achieved 20/25 visual acuity because the lens thickness masked most of the corneal irregularity. Centration and movement were greatly improved compared to the first diagnostic lens.

For the left eye, things didn't proceed quite as smoothly. The final lens that achieved a good fit had the following parameters: 8.20mm:9.50mm/7.80mm: 10.50mm/8.20mm:14.50mm, central thickness 0.37mm. This lens was also designed and manufactured by Eyeart Laboratories in a 49-percent-water hydrogel material from Contamac.



Figure 4: The right eye from the side with the lens for Patient #2.

With a power of $-0.50D$ the patient had 20/200 vision, and over-refraction could not yield any improvement. This obviously resulted from the irregularity of the cornea, which in this eye, as opposed to the right one, could not be masked by the lens thickness. Further proof of this was that when we placed a pinhole of 3mm in front of the eye (and the lens), visual acuity improved to 20/40, again with no improvement when over-refracted.

We concluded that the extreme distortion of the graft caused a severe increase in the corneal aberrations and thus an increase in the diameter of the blur circle on the retina, which we learned that we could minimize by using a 3mm pinhole that allowed only the central and not the marginal rays to reach the pupil. We finally decided to actually paint this 3mm pinhole on the final lens.

Figure 5 shows the final lens. The reverse curve periphery is clearly visible. This lens resulted in 20/50 VA. As expected, during night time the patient reported some difficulty with fluctuating vision, halos, reduced acuity and reduced contrast sensitivity. This obviously occurred because the pupil was becoming wider than the pinhole in mesopic and scotopic light levels. We deemed this acceptable due to the circumstances. However, we did speculate about whether it would have been better to paint the pinhole on the back surface of the lens.

Finding the Right Lens for Each Patient

It's obvious that fitting such corneas is a challenging yet rewarding task for contact lens practitioners. Always bear in mind that diagnostic fitting of post-PK corneas may sometimes become a lengthy and rigorous procedure, and many office visits may be required to first determine the lens type and then to optimize the design and the fit. The reason for this is the unique shape of each transplanted cornea, which leads to sometimes unexpected results.

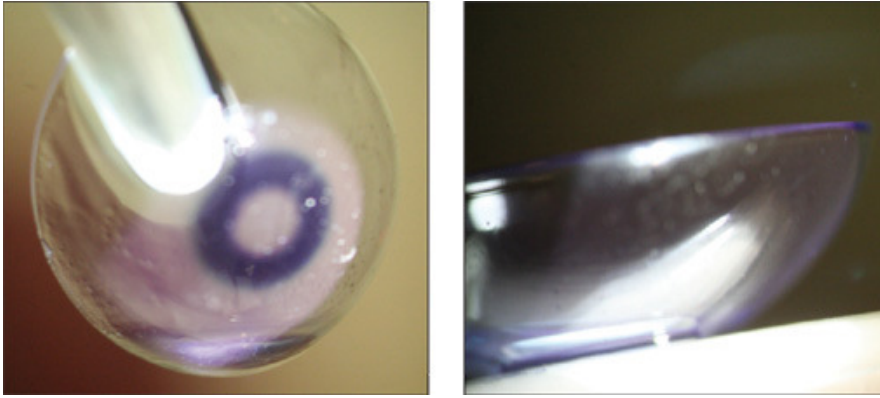


Figure 5: The final lens OS for Patient #2 from its front side (left), and a view from the side where the reverse geometry can easily be seen (right).

For example, if the cornea is fairly regular and you decide to fit hydrogel lenses, you might discover after some follow-up visits that the lens quickly dehydrates on the eye because of an elevated graft that causes the lens edge to be loose and to excessively clear the cornea. You should then reconsider the fitting philosophy and the choice of lens type, even at such a late stage. Make sure to properly bill for your services and for the materials if you refit the patient, preferably using separate fees for the fitting procedure and for the final lenses.

Be prepared to try almost anything in your arsenal to successfully fit these patients, and remember that regular follow-up visits are essential to determine the long-term success of the lens fit and to avoid complications such as graft failure. **CLS**

Mr. Katsoulos is in group practice in Thessaloniki, Greece, and is a consultant to Eyeart Laboratories in the fields of visual optics and optical design.

Mr. Vasileiou is pursuing a degree in Optics and Optometry at the University of Milan — Bicocca, Italy, where he is preparing a thesis on multifocal contact lens design and manufacture for high-order aberration correction of highly aberrated eyes. He has a financial interest in Eyeart Laboratories.

Dr. Karageorgiadis, FBDO, OD, is currently director of a group practice in Thessaloniki, Greece, and director of Eyeart Laboratories.

Dr. Mousafeiropoulos, OD, is in group practice in Thessaloniki, Greece, and consultant to Eyeart Laboratories in the field of contact lens design.



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