Bitoric mini-scleral contact lens fitting of a keratoconic patient following penetrating keratoplasty

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Abstract:
A 24 year-old keratoconic patient is referred for a contact lens fitting of the left eye following penetrating keratoplasty. Resultant high corneal astigmatism is corrected with a bitoric reverse geometry mini-scleral lens with quadrant-specific technology.

Introduction
Keratoconus is a bilateral, asymmetric, progressive, non-inflammatory stromal thinning of the cornea\textsuperscript{1,2}. This condition normally results in high amounts of irregular astigmatism and higher-order aberrations resulting in diminished quality of vision and best-corrected visual acuity\textsuperscript{1,2}. Treatment for keratoconus depends on the severity, and can range from spectacle correction for very mild cones to various types of contact lenses in mild to very severe cones\textsuperscript{1-5}. Small diameter gas permeable (GP) contact lenses are often the first method of treatment in early keratoconus when spectacle visual acuity first becomes affected; these lenses include spherical GPs and specialty aspheric GPs\textsuperscript{1,3-5}. Soft specialty contact lenses are also available in keratoconic designs\textsuperscript{1,3}. As the cone progresses and becomes larger, steeper, or decentered, other contact lens modalities can be used, including limbal GPs, hybrid contact lenses, mini-scleral and scleral contact lenses\textsuperscript{1,3-6}. Other methods of treatment for keratoconus include corneal intrastromal rings (INTACS) and corneal cross-linking procedures to minimize progression or flatten the cone\textsuperscript{1}.

Once best corrected visual acuity drops below 20/40, extensive scar formation, or contact lens intolerance occurs, keratoconic patients typically undergo penetrating keratoplasty (PKP)\textsuperscript{6,7}. In this procedure, clear donor tissue replaces the diseased host cornea, and is affixed with sutures\textsuperscript{3,6}. Patients typically tolerate the procedure well, with low rejection or graft failure rates reported\textsuperscript{8-10}. Following PKP, many keratoconic patients suffer from reduced BCVA, as well as high amounts of corneal astigmatism\textsuperscript{8-12}. Although astigmatism can be adjusted while the surgical sutures are still in place, surgeons have no control over the amount of resultant
astigmatism once the stitches are removed\textsuperscript{11,12}. These patients typically have reduced BCVA despite the clear, healthy graft, and are in need of visual correction\textsuperscript{11,12}. Post-PKP contact lens fits can be complicated and typically require increased chair time for the patient and practitioner with regard to number of follow up visits and various diagnostic contact lens orders\textsuperscript{6,13,14}. However, a contact lens is usually required to regain acceptable visual acuity\textsuperscript{6,13,14}; here, we discuss a case of fitting a patient with a reverse-geometry bitoric mini-scleral contact lens with quadrant-specific peripheral curves following PKP.

\textit{Case History}

A 24 year-old Native American was referred to the clinic by a corneal ophthalmologist for a contact lens fitting of the left eye following penetrating keratoplasty (PKP) in January 2011. The patient complained of blurred vision of the left eye unaided and did not have a habitual spectacle prescription. Systemic medical history was found to be unremarkable, but ocular history was significant for mild keratoconus OD and severe keratoconus OS. The referring ophthalmologist notes high corneal astigmatism resulting from the PKP OS. Family history was insignificant for ocular disease, including keratoconus. The patient was no longer instilling topical medications during the course of this case study, although the patient had recently discontinued a course of Lotemax and Combigan as per the instructions of his ophthalmologist. Prior to the PKP, average-diameter gas-permeable contact lenses were attempted to correct the patient’s vision, with no apparent improvement in vision. A limbal GP contact lens was successfully fit to the right eye, resulting in 20/15 visual acuity; only the fitting of the postsurgical left eye is discussed further in this case report.

\textit{Pertinent findings/diagnostic data:}

Uncorrected visual acuity was: 20/400 OS. Subjective refraction proved to be unreliable and did not improve BCVA. Computerized corneal topography with Medmont E300 corneal topographer (Medmont, Nudawading, Australia) shows 7.3 D of irregular corneal astigmatism OS in a with-the-rule orientation on axial power analysis (as shown in Figure 1A). The irregularity of the graft can be observed in the tangential power analysis (as shown in Figure 1B). Simulated keratometry readings of the left eye were found to be: 48.8D @ 094 x 41.5D @ 004, with marked steepening inferiorly and superiorly to the central 3mm zone. Ocular health is
maintained; the graft is clear and patent with no remaining sutures or complications evident (see Figure 2).

**Figure 1:** Computerized Topography maps OS. A) Axial topography: high corneal astigmatism in a near-with-the-rule pattern  B) Tangential topography showing elevation high corneal surface irregularity.

**Figure 2:** OS corneal graft. Note clear central graft with smooth graft-host junction.

*Treatment:*

A first attempt to vault the cornea and graft junction of the left eye and acquire an adequate fitting relationship was performed using the Essilor Jupiter™ scleral lens. After an in-office diagnostic fit of the contact lens, a diagnostic contact lens was ordered with the following parameters: Essilor Jupiter, central base curve (BC) of 7.03mm, contact lens power (CLP) of -8.00D, and overall diameter (OAD) of 15.6mm. Upon fitting the diagnostic contact lens, it became apparent that the central base curve was extraordinarily steep, as large bubbles obstructing view of the fitting relationship consistently appeared on application. In addition, the patient could not tolerate the lens, as there was excessive movement and continual nasal decentration of the lens due to excessive edge lift. After observing the overall fitting relationship
of the Jupiter™ lens, it was determined that the scleral alignment was also improper, and a mini-
scleral contact lens with greater flexibility in base curve and peripheral curve would be better
suited for an optimal fit\textsuperscript{15}.

In an attempt to refit the left eye, it was decided to change to a mini-scleral lens with
bitoric and quadrant-specific curve technology: the Truform Digiform™ G1 (post-graft) mini-
scleral contact lens in Boston XO material (Truform Optics, Bedford, Texas). An initial
diagnostic lens was chosen from the in-office diagnostic fitting set with the following
parameters: 7.40mm BC, -2.00 CLP, 15.0mm OAD (Digiform™ trial #1). After the lens was
allowed to equilibrate on the eye, a slit lamp examination and over refraction were performed.
An over-refraction of -5.75DS was found to provide a VA of 20/25\textsuperscript{2} OS. Due to the large
irregularity of the cornea corresponding to 7.3D of corneal astigmatism, true alignment was not
observed for the Digiform™ lens. Instead, the lens could be seen to vault well over some areas
of the cornea, while showing excessive touch in other areas, as shown in Figure 3, below.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{image.png}
\caption{Digiform™ Trial #1}
\end{figure}

Bearing in the 180-degree meridian and clearance in the 90-degree
meridian observed with Digiform
diagnostic trial lens #1.

A small fenestration can be observed
at 4:00 in the periphery.

As the fitting relationship closely
mimics the computerized corneal
topography, Truform Optics notes that
a back-surface mini-scleral lens would
align well OS.

Since Digiform™ quadrant-specific technology allows for sectoral peripheral and base
curve changes, a new diagnostic lens was ordered to compensate for the large variance in corneal
topography utilizing a slit-lamp photo of the lens-fitting relationship in combination with the
patient’s topography. The lens parameters and images were sent to Truform Optics and a new
diagnostic lens was ordered with the following parameters: Truform Digiform™ 8.30mm x
7.40mm BC, -2.50D x -7.37D CLP, 15.0mm OAD (Digiform™ trial #2).
At the next contact lens dispense examination, the Digiform™ trial lens #2 (parameters described above), was inserted into the left eye and allowed to equilibrate. In-situ visual acuity was found to be 20/15 for the left eye. A careful evaluation of contact lens alignment showed an area of large central bearing in a near-spherical apical touch pattern, as can be observed in Figure 4, below. A careful over-refraction showed no improvement in BCVA of the left eye. Although central bearing was observed, the Digiform™ trial #2 contact lens appeared to be of an overall better fitting relationship for the corneal toricity as compared to the Digiform™ trial #1.

A re-order of the Digiform™ trial #2 contact lens was warranted, with an increase in overall sagittal height by 125µm to compensate for the low vault observed. Upon further examination of the fitting relationship of the Digiform™ trial #2 contact lens, it was noted that the graft-host junction and limbus were vaulted well. Some nasal edge lift was observed, and so a toric periphery was ordered to minimize the movement and discomfort of the lens in this area. In addition, the fenestration allowed for bubble formation with increased wear time and gazes away from primary gaze; the fenestration was requested to be removed from all future orders to minimize this effect.

A third Digiform™ contact lens (Digiform™ trial #3) was ordered with the following parameters: Truform Digiform™ 7.70mm x 6.96mm BC, -5.62D x -10.25D CLP, 15.0mm OAD. After the contact lens was allowed to equilibrate on the eye, in-situ VA was found to be 20/25 for the left eye. An over-refraction of -0.50 DS improved vision to 20/20 OS. Although the lens appeared to have apical touch at first glance, a very thin fluorescein layer of about 20µm was
observed between the contact lens and the central graft. The overall fit showed a “c-pattern” area of near-apical touch surrounding a central clearance area of about 70µm (see Figure 5, below). Graft-host junction and limbal areas showed maximal clearance 360-degrees of the cornea. Good scleral alignment was observed with no blanching or edge lift. This lens was near alignment, and we reordered the lens with a further increase in sagittal depth via central BC changes, while keeping the limbal and peripheral toric curves constant.

Another trial lens was ordered to increase the overall sagittal depth and maintain the good ocular health of the graft and donor tissue. This diagnostic contact lens, Digiform™ trial #4, was ordered with the following parameters: Truform Digiform™ 6.93mm x 6.36mm BC, -11.00D x -15.25D CLP, 15.0mm OAD. The patient is scheduled for dispense of the mini-scleral contact lens, and will be returning for follow-up on fit, ocular health, and vision before the American Academy of Optometry meeting in Phoenix, AZ, October 2012. At the time of his return, he will be instructed on proper application and removal; after demonstrating these techniques, he will be allowed to use the Digiform™ trial contact lens for 2 weeks. The patient’s corneal health will be closely monitored and a report of findings will be sent to the referring ophthalmologist.

Conclusions

Although contact lens fitting following penetrating keratoplasty can be a complicated and labor-intensive process for the practitioner, the vision restored to the patient with a contact lens
following graft surgery can dramatically influence a patient’s life. In our case, the patient’s vision showed significant improvement with a scleral contact lens versus unaided vision with no threat to ocular health. Our patient’s post-surgical corneal condition prevented a reliable spectacle prescription, and so contact lenses provided the only viable option to increase visual acuity. This particular case involved several follow-up fitting visits (5 visits in this case), but the vision and comfort of the lens far exceeded the patient’s expectations. Although we specifically followed a keratoconic patient post-PKP, the resulting fitting relationship of a contact lens can be predicted to be similar for any post-PKP case. Studies indicate that high residual corneal astigmatism and decreased BCVA can occur after PKP, regardless of the initial disease state of the eye. Again, corneal health must be maintained throughout contact lens wear, as the risk of graft failure increases with poor-fitting or low oxygen-permeable contact lenses. Therefore, a detailed approach is necessary when fitting a contact lens that will vault the graft-host junction, minimize irregular astigmatism, correct visual acuity, and provide acceptable patient comfort.

References:


