An Unorthodox Keratoconic Fit Using a Reverse Piggyback Lens System

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Abstract

Background*:* In today's toolbox there is a variety of contact lenses available for patients with corneal ectasias or irregularities. Balancing both vision and lens comfort has been made easier with the availability of lenses including sclerals, hybrid lenses, and piggyback lenses.
Case Report: A 24 year old previously undiagnosed keratoconic patient was referred for evaluation and contact lens fitting. The right eye was initially fit with a scleral lens for optimal vision and comfort. Despite an acceptable fit, the patient was bothered by image ghosting in the scleral lens and was re-fit into a reverse piggyback lens system.
Conclusion: The image ghosting, most likely attributable to higher order aberrations, remained present in the reverse piggyback system; however, it was more tolerable to the patient than the scleral lens. Although not the first choice of lens modality, the reverse piggyback system met the patients needs while providing both comfortable fit and improved vision.

Background

Fitting contact lenses on patients with corneal ectasias or irregularities can be a complex process. Traditionally, small diameter gas permeable (GP) lenses have been used to achieve optimal vision; however, not all patients are successful in corneal GP's.

When patients are intolerant to GP lens wear, comfort is often cited as a contributing factor.[1] Fortunately there are a variety of contact lens options that can provide both optimal vision and improved comfort including scleral lenses, hybrid lenses, and piggyback lenses. In many cases these lenses are becoming the preferred first choice by contact lens practitioners.

Scleral lenses are growing in popularity due to their wide variety of indications and improved lens designs. These large diameter lenses vault the cornea and rest on the sclera and overlying conjunctiva, allowing for on-eye stability and improved comfort. When inserting the lens, non-preserved saline solution is used to fill the lens, which bathes the cornea in fluid and masks corneal irregularity. Although lens handling can be an issue, with proper instruction and motivation most patients are successful in these lenses.

Hybrid lenses have a GP center with a soft lens skirt, which assists with both lens centration and comfort. Early generations were limited by their complications; however, improvements in lens design, including utilizing a silicone hydrogel skirt and reverse

geometry in the GP center, have helped to make these lenses a viable option for irregular corneas.

While not often considered as a first line approach in fitting, piggyback lenses can be an effective option. Piggyback lenses involve a soft lens fit beneath a GP lens. If patients with a previously successful GP fit begin to experience discomfort or compromise to corneal integrity, the soft lens is used to protect the cornea and improve comfort. In other cases the soft lens can be used to improve centration and fit of the GP lens by manipulating refractive power or base curve of the soft lens. When choosing a soft lens, a high DK silicone hydrogel material is preferred to minimize the risk of complications from hypoxia. The soft lens should still have movement allowing for adequate tear exchange, while not demonstrating any edge lift or fluting. The GP lens, also of a high DK material, should center over the soft lens without binding.

The following case discusses a keratoconic patient originally fit in a scleral lens. Although comfort was not an issue, the patient preferred to be re-fit into a corneal GP lens. To prevent the lens from becoming dislodged during physical activity, a soft lens was placed over the GP in a reverse piggyback system.

Case Report

Case History:
A 24 year old Caucasian female was referred to the University Eye Center in March 2013 for a corneal topography and evaluation for suspected keratoconus. At the initial evaluation, the patient complained of blurred vision, photophobia, poor night vision, and diplopia in the right eye only. She presented with spectacle correction only and denied any history of ocular trauma or disease. Systemic health was unremarkable.

Examination Findings/Diagnostic Data:
Subjective refraction yielded visual acuity of 20/70 in the right eye (OD) and 20/25+ in the left eye (OS) with correction of -2.25 -2.00 x115, and -2.00 -2.50 x080 respectively. Biomicroscopy revealed inferior apical thinning of the corneal stroma in both eyes, with right eye worse than left. Corneal topography was performed with the Medmont E300, confirming the diagnosis of keratoconus. Topography of the right eye (figure 1) revealed an inferior oval cone with simulated keratometry readings of 60.5 D @162/52.5 D @072. At its steepest point, approximately 3.5 mm inferior to the center of the pupil, the cornea measured 75.8 D. Topography of the left eye (figure 2) revealed a milder inferior oval cone with simulated keratometry readings of 46.2 D @004/45.0 D @094.

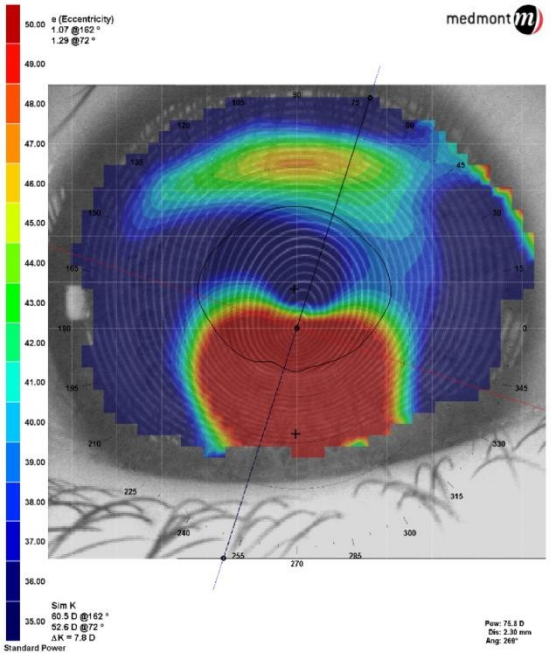

Figure 1 OD Tangential Map

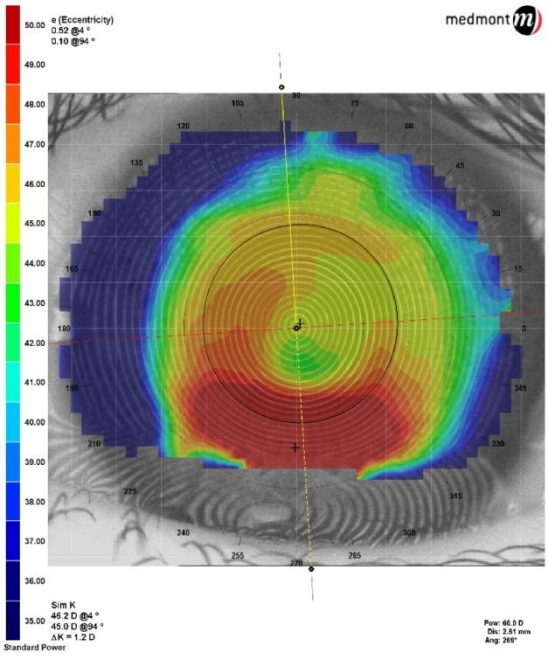

Figure 2 OS Tangential Map

Contact Lens Fitting/Follow Up:
The patient returned to the clinic in June of 2013 for a contact lens fitting. Using a diagnostic fitting set, the right eye was fit with a Europa Scleral™ lens (Visionary Optics). The following parameters were ordered: overall diameter (OAD) 16.0 mm, base curve radius (BCR) 7.03 D, contact lens power (CLP) -4.00 D, with two additional diopters of reverse curve added to the lens.

The left eye was fit in a Biofinity® Toric (CooperVision) soft lens with a power of -1.75 -2.25 x050. The left lens was well centered with 5 degrees rotation left and yielded visual acuity of 20/40. With an over-refraction of Plano -2.50 x120, the patient was corrected to 20/25+. Using a cross cylinder calculator a new power of -3.50 -1.25 x090 was determined. A trial lens of this power was dispensed to the patient.

At the dispense appointment for the right eye, this lens yielded visual acuity of 20/40. There was approximately 400 microns of central clearance and good clearance over the limbus. There was mild peripheral blanching of several vessels inferiorly at six o'clock, but an acceptable peripheral fit elsewhere. Good comfort and vision was reported in office. After instruction on insertion and removal, proper lens care, and building up wear time, the patient was scheduled to return wearing the lenses in one week to monitor lens settling.

At the follow-up visit, the lens was reported to be comfortable and fit well with approximately 350 microns of central clearance after several hours of wear. However,

the patient complained of constant monocular image ghosting out of the right eye. Visual acuity was measured at 20/30-, with an over-refraction of Plano -2.00 x060 giving acuity of 20/25-; however, the ghosting was not eliminated. Topography was taken over the lens, which ruled out flexure of the lens. Having never worn a contact lens previously, one or two more weeks of adaptation was suggested. At that point if the image ghosting was still present, an aspheric front surface or other options would be explored.

Two and a half months later the patient returned still complaining of image ghosting. Although the patient had been non-compliant with follow-up care, she expressed the desire to continue trying contact lenses. Unfortunately her lens warranty expired in three days. After discussing her options, she elected to return the scleral lens and try a smaller diameter gas permeable lens.

The right eye was re-fit using diagnostic lenses of an 8.7 mm Tru-Kone (TruForm Optics), an 11.2 mm Rose K2 IC (Blanchard), and a 15.6 mm Jupiter scleral (Essilor) all with an acceptable fit. With a sphero-cylinder over-refraction, image ghosting was still noted in each lens; however, the separation of the images was the greatest in the Tru-Kone and the least in the scleral lens. Despite the largest degree of image separation, the vision with the Tru-Kone was the least visually confusing. The following parameters were ordered: BCR 5.30 mm, 8.7 mm diameter, CLP -18.00-1.00 x040, and one step flatter peripheral curves.

While discussing with the patient that a smaller diameter lens may move or decenter, she expressed concern about the lens dislodging during karate class and other physical activities. In order to prevent this from occurring, a soft lens was to be used to drape over the gas permeable lens as a reverse piggyback system. Because of the steepness of the cornea and location of the apex, no stock silicone hydrogel lenses provided adequate coverage of the GP lens. An Intelliwave® (efrofilcon A, Art Optical) custom soft lens with a DK value of 60 was ordered with a 7.8 mm BCR, 14.5 mm diameter, and CLP Plano. Additionally, the Tru-Kone was changed from Boston ES to Boston XO (DK 100) for improved oxygen permeability.

At the dispense appointment the Tru-Kone lens was centered over the inferior cone with light three-point touch. The flatter peripheral curve system provided improved edge lift from the diagnostic set. The Intelliwave® custom soft lens gently draped over the gas permeable lens with good coverage and no edge fluting (figures 3 and 4). There was a 0.50 mm lag on the blink and good comfort was noted. Visual acuity yielded 20/40 OD with image ghosting that was tolerable to the patient. Although there was rotation of the lens, the front surface toricity did not negatively affect vision. No improvement was

noted on over-refraction and the patient expressed no interest in exchanging the lens. At the two week follow-up visit, vision and comfort of the lens was stable. The lenses were removed to check corneal integrity, which was intact. A follow-up visit was then scheduled for six months.

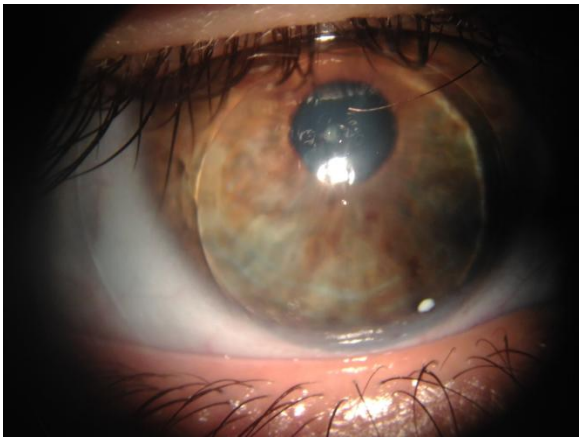

Figure 3 Reverse Piggyback System OD

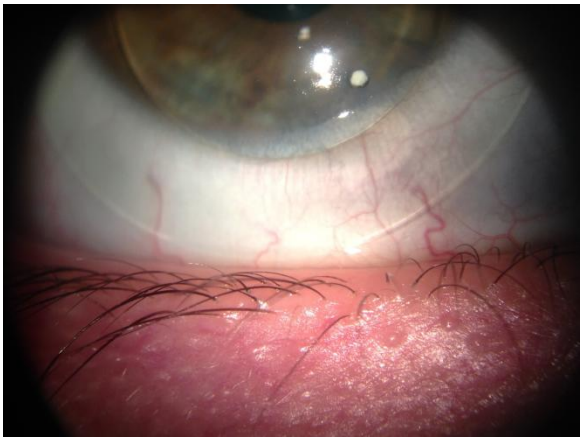

Figure 4 Edge profile on up gaze OD

Conclusion

Every so often there are those cases where the contact lens fitting doesn't go as planned. Despite what appears to be an acceptable fit, the patient may be unsatisfied for one reason or another. In this case a scleral lens was fit initially to provide optimal vision and comfort. Visual acuity was improved from spectacles and the lens was comfortable, but the image ghosting was bothersome to the patient.

The image ghosting the patient experienced is most likely attributable to higher order aberrations (HOA), which degrades the retinal image and visual quality.[2] In addition to irregular astigmatism, keratoconic eyes have increased HOA's compared to the normal eye.[3] The rigid surface of a GP lens and the tear layer serves to mask any anterior corneal irregularities, which can reduce HOA's.[3, 4] However, not all HOA's can be eliminated. Irregularities in the posterior corneal surface cannot be corrected with a contact lens, and in some instances the GP lens can further induce HOA's.[5] This patient experienced image ghosting in both scleral lenses and GP lenses. Based on subjective observation, the scleral lens reduced the HOA's more than the GP, but was more visually confusing. Even with the image ghosting, visual acuity in both lenses was preferable to spectacles.

Although the reverse piggyback system is not the first choice of lens modality, it meets the needs of this patient. The GP lens alone provides acceptable vision and comfort, but would likely dislodge during intense physical activity. It was recommended that the

soft lens be used part-time during such activity; however, with proper monitoring it may be acceptable for more full time use.

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