

Clinical & Refractive Optometry is pleased to present this continuing education (CE) article by Dr. Langis Michaud entitled **A Case of Corneal Warpage**. In order to obtain a 1-hour Council of Optometric Practitioner Education (COPE) approved CE credit, please refer to page 291 for complete instructions.

A Case of Corneal Warpage

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ABSTRACT

Corneal warpage is defined by a distortion of the cornea secondary to contact lens wear. This is expected to occur when the contact lens to cornea relationship is not optimal, especially when the corneal tissue is severed by chronic hypoxia.

Corneal warpage is expected with the wear of PMMA lenses, and quite commonly occurs with the use of rigid gas permeable (RGP) lenses, namely when the base curve of the lens is flatter than K by at least 0.75 D. Aspheric GP bifocal lenses are also known to initiate corneal distortion over time. The induced distortion can also occur in the presence of hydrogel lenses. In fact, recently published papers estimate that up to 40% of contact lens wearers suffer from corneal warpage. This is not surprising, considering that most pHEMA lenses, either disposable or conventional, are known to create chronic hypoxia over time, based on the works of Harvitt and Bonnano. The minimal DK/t of a lens that respects corneal physiology is 32 for daily wear and 120 with extended-wear mode. None of the standard products we prescribed a few years ago match these criteria. This is why switching from this old technology to silicone hydrogel is increasingly becoming the standard of care.

INTRODUCTION

A warped cornea will not induce any symptoms, but a few clinical signs can be tracked if the practitioner pays enough attention. The first manifest sign is a change in refraction that is not expected at this time point in the

patient's evolution. Typically, a contact lens wearer of 35 to 40 years old becomes more myopic and less astigmatic over time, if one compares the actual refractive results with the findings of 5 years prior. Sometimes, a change in the axis of the astigmatism occurs. Under the slit lamp, the limbal area will be evaluated as engorged, with some blood vessels protruding in the area. Note that this occurrence should not be confused with a neo-vascularization process. The limbo-corneal area will appear frosty instead of clear, as usual. A few patients will experience discomfort induced by the contact lenses and will report halos and glare at night, but this is the exception rather than the rule.

The only way to identify corneal warpage is to perform topography. The maps are significant in identifying an asymmetry between the superior and inferior parts of the cornea. Some authors have called this type of mapping "pseudokeratoconus," as the bottom cornea is steeper than the upper one. This is mainly due to the movement of fluids on the epithelial layer that accumulate, under gravity, on the lower cornea.

This Case Report illustrates how corneal warpage can appear, and how to restore the corneal condition.

SUBJECTIVE

MP was a 67-year-old lady seen for the first time in April 2008. She wanted to renew her contact lens prescription. She had been fitted many years ago in monovision by an ophthalmologist, and was recently retreated, which led to her consulting me on his recommendation.

At the initial visit, she reported being very happy with her lenses, relying on good visual acuity at far, at near, and at computer distance. She had been wearing Acuvue® 2 lenses for more than 10 years (OD +3.50 /OS +2.25), without any discomfort or dryness at the end of the day. She admitted to wearing the lenses on a continuous wear basis for 30 nights most of the time, as she had not been instructed to dispose of the lenses before that time. She very rarely used comfort drops, and did not use any care regimen. She was known to have type II diabetes, which was stable and well controlled with oral medication. She denied taking insulin. Her ocular health was good, with no glaucoma or cataract to her knowledge.

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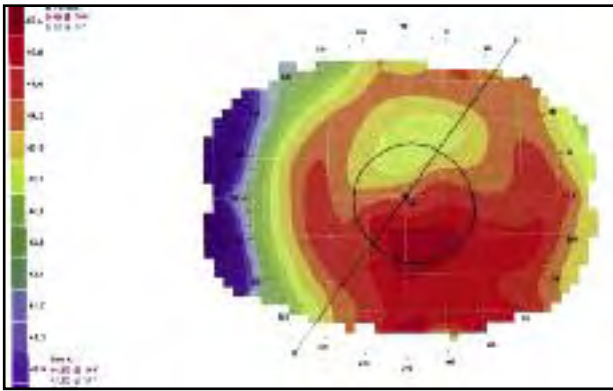


Fig. 1 Initial OS topography map showing moderate corneal warpage. Note the W shape of the distortion. In refractive surgery, this is considered an exclusion criterion. These corneas are more prone to warpage and are unstable post-surgery, which can lead to negative outcomes.

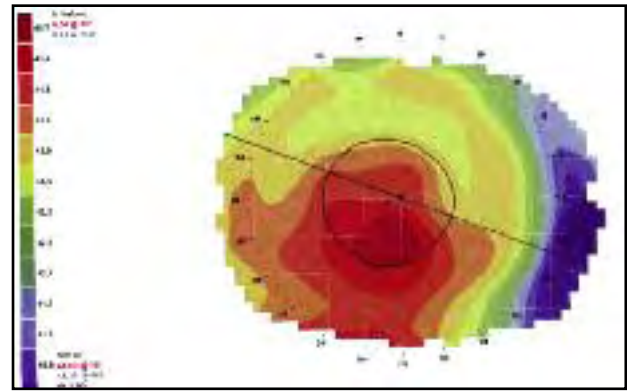


Fig. 2 Initial OD topography map showing higher E values compared with OS (0.36@70/0.62@160; OS 0.46@144/0.32@54).

OBJECTIVE

Entering visual acuities with the contact lenses on were 6/15 (20/50) OD and 6/9+1 (20/30) OS improvable to 6/7.5 (20/25) and 6/6-2 (20/20), with an over-refraction of -1.00 -0.75 x 65 OD and -0.75 OS. Obviously, the right eye was fitted at intermediate/near and the left eye was fitted at far. The lenses were evaluated as well centered and positioned. They showed protein and lipid deposits, and a few mucin balls were seen under both surfaces.

Upon removal of the contact lenses, the cornea showed a grade 1+ diffuse staining OU, with dimple veiling corresponding to the mucin balls locations. There were 15 to 20 microcysts on the central cornea OU. At the limbus, a frosty area surrounding the cornea was seen, with neovascularization invading the corneal tissue by 0.5 mm x 360 degrees. There were no follicles, and papillae grade 1+ without hyperemia were seen on the superior palpebral conjunctiva OU. The crystalline lens showed central and posterior sub-capsular opacities grade 1 + OD and grade 1- OS. Irido-corneal angles were opened and intraocular pressure was measured at 18 mm Hg, compensated for by pachymetry of 575 um OU.

The corneal topographer was not available at the time of this visit, so this examination was postponed. The refractive findings were OD +2.50 -0.25 x 35 6/6-3 (20/20) and OS +2.00 -0.75 x 105 6/6-1 (20/20). There were no abnormal findings on binocular testing. Dilated fundus examination revealed no diabetic retinopathy.

ASSESSMENT

The patient in this case was evaluated to have hyperopia, astigmatism and presbyopia. Even though the patient appeared to be pleased with the outcome, the contact lens correction was evaluated as suboptimal. There was vascularization, along with signs of chronic hypoxia on

both corneas. Fortunately, there was no diabetic ocular side effect.

PLAN

It is always easier to find the best product to match a patient's behavior than the other way around. With this patient having relied on monovision and extended-wear for so many years, the goal of the treatment plan was to include these elements in order to succeed. The only way to address both issues while improving the visual acuity and the ocular health was to switch to silicone hydrogel lenses. Considering the hyperopic prescription of the patient, implying a thicker lens with reduced permeability, and the presence of astigmatism on the left eye, monovision made even more sense. On the other hand, it would have been suitable to maintain binocular vision with the use of bifocal contact lenses; however, the only toric multifocal disposable lenses on the market did not offer enough permeability to meet our needs. This is why, as a first trial, we suggested a modified monovision fit, implying the use of a multifocal lens on the non-dominant eye, with a toric lens on the dominant one. Therefore, PureVision® Multifocal (+3.00 high add) and PureVision Toric® (+2.00 -0.75 x 105) were fitted. They gave 6/7.5 (20/25) at far and 0.5 M at near. The patient reported lens awareness, which is expected when switching from a thinner lens with a lower modulus, such as Acuvue 2, to a higher modulus, thicker lenses such as PureVision. The patient was instructed to maintain continuous wear and a follow-up exam was planned 1 week later. Blink™ comfort drops were provided for PRN use.

Follow-up Number One

After a week of continuous wear, the patient was not very happy with her new contact lenses. The comfort was not

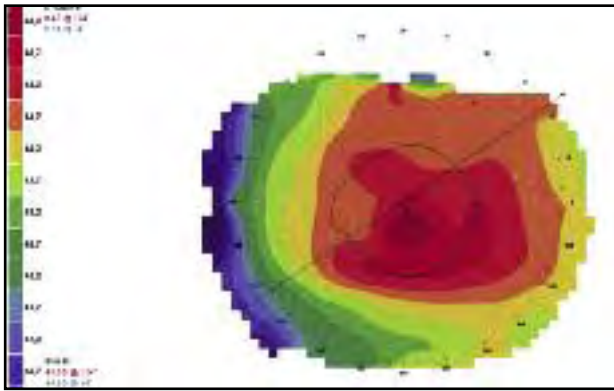


Fig. 3 Final OS. Restored corneal profile, without W shape seen initially.

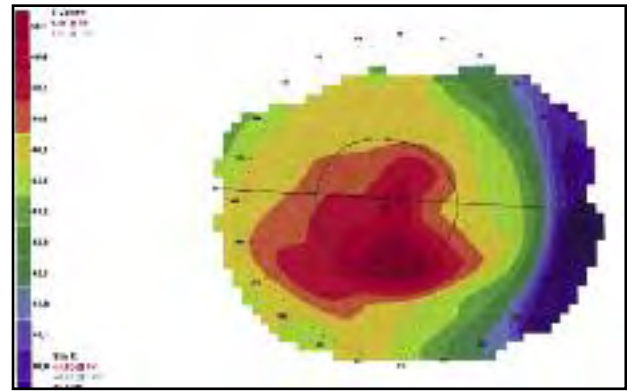


Fig. 4 Final OD. Cornea is more spherical and symmetrical after 3 months of corneal rehabilitation.

as expected, her visual acuity remained reduced compared to her previous fit and, moreover, she was not able to tolerate the lenses on extended-wear for more than 3 days, mainly due to dryness and discomfort.

Entering visual acuities were 6/15 (20/50) at far and 1.0M- at near, not improvable with over-refraction, but reaching 6/7.5 (20/25) with pinhole. Refractive findings were +2.50 OD [6/12- (20/40)] and +2.00 OS 6/9- (20/30).

Under the slit lamp, the lenses were evaluated as well positioned and centered. Their surface was colonized by heavy lipid deposits. There were no mucin balls; however, the cornea showed grade 1+ staining. There was a slight increase in the amount of microcysts in the central cornea OU. The vascularization had begun to resolve and the bulbar hyperemia was gone. Topographic maps were performed showing a moderate to severe corneal warpage (Figs. 1,2).

The assessment at this time required a change in the refraction since the left astigmatism was no longer present and the cornea seemed to be in better shape. The reduced visual acuity might have been linked to the lipid deposits on the surface of the SiHy lenses, but even without the lenses there was a reduction of vision compared to the first visit. The only explanation was corneal warpage.

It is important to note that, most likely, the cornea was already warped at the previous visit: the patient had a chronic lack of corneal oxygenation and wore her lenses for a month at a time, which meant using a low DK lens on an extended-wear basis. Restoration of the corneal tissue begins at the very moment that enough oxygen reach its surface. In the 1990s, Dr. Roy Rengstorff demonstrated that the cornea moves a lot during the first 3 weeks following the withdrawal of a PMMA lens from a cornea. The longer the hypoxic phenomenon occurs, the longer the restoration period will be. Traditionally, in

my experience, it takes from 3 weeks to 3 months for the cornea to return to its normal state. In fact, at that time, the tissue tends to adopt a natural shape similar to its pre-contact lens appearance. If the warpage is severe, this is not possible and some distortion remains. However, for most of the patients considered low to moderately warped, the cornea becomes symmetrical again after several weeks.

It is challenging to explain this to a patient and to pursue a treatment plan. It would be easier to revert to the previous lenses, but the practitioner has to bear in mind that a warped cornea should be addressed, especially in an older patient, considering the negative impact it could potentially have on ocular surgery and IOL calculation, for example.

During the restoration period, some variability can be expected in visual acuity, refraction, and topographic/keratometric values. In fact, the process of restoration is considered over only when, at two separate visits, the cornea shows similar K values, and its shape and refraction remain the same.

Considering the patient's discomfort, the change in refraction, and the need to maintain good permeability of the contact lens material, it was decided to fit Acuvue® Oasys™ (OD +4.00; OS +1.75) for 2 weeks. The patient was asked to not wear the lenses overnight, as much as possible. Opti-Free Replenish care regimen was provided and formal instructions to rub and rinse the lenses were given.

Follow-up Number Two

The patient was seen again two weeks later and she reported to have worn the lenses overnight just 5 times. Her comfort with the lenses was good but her vision remained below her expectations. Entering visual acuities were 6/9 (20/30) at far and 0.8 M at near. Subjective

refraction gave +2.50 -1.00 x 20 OD (6/6-1 (20/20)) and +1.75 -0.75 x 165 (6/6-1 (20/20)) OS.

Slit lamp examination revealed improved ocular health. The oculo-limbal area was no longer engorged with blood vessels and the junction was clearer. There was no neovascularization, and a few corneal staining dots were present OU. Microcysts were still present but this was expected to last at least 3 months once the hypoxic stress was relieved. Topographic maps showed improved but still warped corneas. Sim K values indicated a steepening of both corneas, ranging from 44.3 x 44.8 @ 70 to 44.6 x 45.4 @ 82 for the right eye and from 43.8 x 44.6 @ 144 to 44.7 x 45.5 @ 148 for the left eye.

Toric contact lenses were tried without significant better outcomes compared to the spherical ones. In order to improve the near vision, the right eye was upgraded to +4.75 and the left eye remained corrected at +1.75.

Follow-up Numbers Three to Seven

The patient was seen every two weeks after follow-up visit number two. At the last visit, in July 2008, three months after the initial evaluation, the patient seemed happy with her contact lens wear.

During the previous weeks she had been experiencing fluctuating visual acuities and relative comfort with the lenses on. After the third follow-up, since the restoration was not progressing as had been expected, the lenses were switched for the highest DK material available on the market (Iotrafilcon A- Focus Night & Day) and overnight wear was strictly forbidden. The cornea seemed to respond well to this change and the visual acuity improved both at far and at near. At the sixth follow-up visit, the patient was fitted with senofilcon A (Oasys™) because of a comfort issue with higher modulus lenses (Focus Night and Day™) that she could no longer tolerate. For daily wear, which the patient had adhered to, the permeability of this Oasys material is more than sufficient to maintain good ocular health and to alleviate further delays in the restoration of the cornea.

At the last visit, the refractive findings were OD +2.25 -0.50 x 90 [6/6 (20/20)] and +1.75 -0.75 x 95 [6/6 (20/20)]. Topographic maps (Figs. 3,4) show an almost regular and symmetrical pattern on both sides, with a small astigmatic shape on the left eye. Sim K values were OD 44.6 x 45.7 @ 78 and OS.

Accordingly, the patient's final fit was made with Acuvue Oasys +4.00 on the right eye and Acuvue Oasys for Astigmatism™ on the left eye +2.00 -0.75 x 90. This proved to be adequate at all distances, namely at the computer distance. The patient reported that the lenses felt comfortable since they were not prone to lipid deposition, as were the balafilcon A material the patient had previously tried. The care regimen (Opti-Free Replenish™) included the essential step of rubbing and rinsing before overnight soaking. For this patient, continuous-wear was banned for life. Flexible wear lenses (occasional extended-wear) were not authorized at the last visit, but might be considered over the next 3 months. However, wear should not exceed more than 2 nights per week since a cornea that was warped once is more fragile and could be easily distorted in the future.

For this patient, senofilcon A lenses were optimal, based on their oxygen permeability versus comfort balance; the replacement schedule limiting deposits and their side effects; the UV protection (cataract prophylaxia); and their behavior on the eye.

CONCLUSION

Corneal warpage occurs more often than expected in soft contact lens wearers, namely due to the limitation of permeability of many currently prescribed disposable contact lenses. If corneal warpage is suspected, the patient has to be re-fitted in higher permeability materials. It is not possible at this time to completely eliminate the contact lenses, restricting oneself to correction with glasses only, since the refraction would fluctuate greatly in the following weeks. The patient must be followed up and disposable lenses should be provided as parameters change. Corneal topography is mandatory for comprehensive management of these cases.

Corneal restoration post-warpage is expected take up to 3 months, even though the majority of the cases will be resolved within 3 weeks. During that time, the patient must be followed-up and reassured, if necessary, regarding fluctuations of the clinical signs and symptoms. Most patients can be refitted upfront without any problem, as they suffer from low to moderate warpage. Patients with more severe cases should be educated about their condition and expected outcomes. Moreover, the benefits of treatment over the long term should be clearly stated.