CONSULTATION SECTION: REFRACTIVE

Toric implantable collamer lens implantation in a patient with keratoconus

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A 39-year-old woman was seen because of dissatisfying results after an implantable collamer lens (ICL) (Visian ICL, STAAR Surgical Co.) implantation in the left eye. The ICL implantation was performed in 2017 because of stable keratoconus with contact lens intolerance. The preoperative corrected distance visual acuity (CDVA) was 20/25 in the right eye (−1.25 −3.0 × 40) and 20/25 in the left eye (−0.25 −7.25 × 145). A 13.7 mm ICL (−7.5 +6.0 × 54) was implanted in the left eye at the horizontal axis. Postoperatively, the ICL was repositioned three times because of rotation.

At present, the patient's uncorrected distance visual acuity (UDVA) is 20/30 and the CDVA is 20/20 (+1.25 −3.0 × 120) in the left eye. She reports blurry vision with diplopia. Biomicroscopy shows a posterior chamber phakic intraocular lens (pIOL) with central flow positioned on the 165-degree axis. There was some iris pigment seen on the anterior surface of the ICL. The anterior segment optical coherence tomography (AS-OCT) (Casia SS-1000, Tomey Corp.) showed a lens vault of 748 μm (Figure 1). The endothelial cell density was 2400 cells/mm^2 and intraocular pressure (IOP) measured 13 mm Hg. Figures 2 and 3 show the postoperative Scheimpflug tomography (Pentacam HR, OCULUS Optikgeräte GmbH) and aberrometry (IRX3, Imagine Eyes), respectively.

What do you advise for this patient?

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Toric ICL is a safe and effective alternative for astigmatism correction with a good rotational stability[1]; however, it is well known that its diameter calculation could be problematic and could lead to vault-related complications, more importantly, in keratoconus cases. This occurs because sulcus-to-sulcus (STS) and white-to-white (WTW) measurements do not always have a predictable and reliable correlation and different devices have important WTW measurement variability.[2]

Rotation could be expected if a too small lens is used, which would cause suboptimal haptic support and a low vault; however, in the presented case, the largest available model of ICL was used and the vault is within a normal range. Considering that, the reason for rotation must be explained by something at the contact sites of the haptics with sulcus, which could be the presence of ciliary body cysts,[3,4] an anterior ciliary body, or some type of haptics malposition or a missing/broken haptic. According to the above, we would recommend an ultrasound biomicroscopy to confirm or rule out anatomic issues. It would also be important to ask about intense physical activities that could increase rotation risk.

To determine how to treat this case, it is important to determine whether rotation occurred during the early postoperative period (but refraction is stable now) or whether, on the contrary, rotation is still occurring and the refraction is changing.

In any of these two scenarios, we consider that the best option would be ICL removal as the first surgery; then, 4 to 6 weeks later, we would perform a new refraction, corneal topography/tomography, and WTW measurement, ideally by different methods and in different axes to calculate a new ICL and implant it as the second surgery. We recommend choosing a toric ICL for oblique or even vertical implantation; this is especially important if ciliary body cysts located at the initial alignment site were identified. Another valid option, especially if posterior vitreous detachment were confirmed, would be ICL removal and refractive lens exchange with a toric IOL, so the anatomical site of implantation would be different, and this would probably solve the problem. However, because of the patient's young age, no cataract presence, and accommodation, we would not consider it as our first option, although multifocal IOLs or even extended depth-of-focus pIOLs could be considered. However, because the use of this type of IOL in keratoconus is controversial and debatable, a monofocal toric IOL would be a safer option.

If rotation occurred only during the early postoperative period and the current refraction has been stable, corneal refractive options could also be considered, including refractive procedures combined with corneal crosslinking (CXL); nevertheless, the additional induced thinning and the risk for affecting the current CDVA should be analyzed. Intrastromal corneal ring segments (ICRS) could also be an

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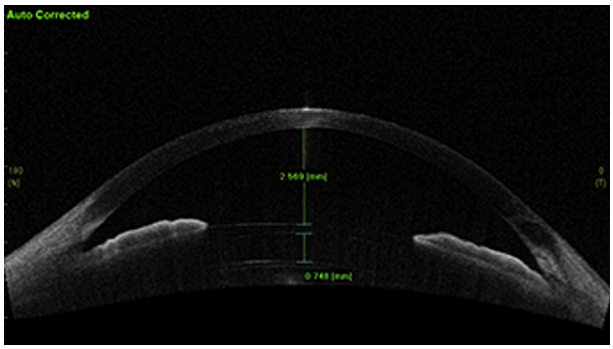

Figure 1. Postoperative anterior segment optical coherence tomography of the left eye.

option to decrease astigmatism; however, they would not be the preferable option for mixed astigmatism.

Last, but not least, a new contact lens can be tried, bearing in mind that with the current astigmatism, a soft, a rigid gas-permeable (RGP) or a scleral contact lens could solve the problem.

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The implantation of an ICL for myopia and myopic astigmatism in eyes with keratoconus has a great potential to end with an unpredictable outcome because of cone, irregular astigmatism, and instable refraction. Changing refraction and progression of the disease because of the biomechanically instable cornea causes fluctuation in vision. In the presented case, a hypervault of the implanted ICL also caused pigment dispersion and an imprecise refractive outcome. Because the patient reports blurry vision with diplopia in the left eye, a surgical correction is warranted.

I recalculated the ICL from the given information and came to another result of the ICL power than what has been inserted into the eye. In addition, the ICL seems to be oversized, which can be seen by the severe vaulting of 748 µm in AS-OCT. Therefore, I would suggest exchanging this ICL. First, the easiest option would be to change the refractive error; however, it is worth noting that corneal surgery is not indicated to change the refractive error here. Second, the pigment dispersion might be caused by the oversized IOL, and it can be reduced with a smaller ICL. A 13.2 mm ICL (−6.5 +6.0 × 55) at the horizontal axis should be implanted followed by the rotation to 7 degrees. A lens with the spherical equivalent (SE) near plano is not possible because the ICL is only available with a cylinder of 6.00 diopters (D). I would choose a −6.00 D or −6.50 D in the sphere so that there would be no remaining sphere in the minus cylinder notation.

Surgically, the ICL exchange is straightforward. Regardless of the previous incision side, I would use a temporal posterior limbal incision because it is the most astigmatic-neutral incision for small-incisional surgery. Ophthalmic viscosurgical device (OVD) should be injected in front and behind the current pIOL to protect endothelium and the crystalline lens. The explantation can be done in the longitudinal fashion, grabbing the ICL starting from the peripheral flange and then the pIOL optic. The other option is to remove the IOL perpendicular to the main incision and remove the optic first followed by the two flanges. The new ICL is then inserted under OVD protection into the anterior chamber in the regular fashion followed by ICL location behind the iris and correct positioning with the special ICL spatula.

In summary, to help this patient, I would recommend that the ICL in the left eye is removed and a new ICL (13.2 mm ICL [−6.5 +6.0 × 55]) is implanted at the axis of 7 degrees.

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The blurry vision and diplopia are most likely attributable to corneal irregularities secondary to the keratoconus. Although the toric ICL might improve the regular astigmatic component, assuming it will stay in the correct axis, it does nothing to improve higher-order aberrations (HOAs).

As a first step, I would explore whether the patient is truly contact lens intolerant because the right contact lens could resolve a number of these patient's issues more easily than other options.

To avoid unnecessary surgery, including explanting the toric ICL, the next recommended step would be to attempt to fit the patient with a scleral contact lens. Keratoconus patients frequently have contact lens intolerance from RGP lenses because they often poorly fit to the highly irregular corneal surface. Scleral contact lenses have the advantage that they rest on the relatively nonsensitive scleral tissue and completely vault the highly sensitive corneal surface. The semisealed fit of a scleral contact lens provides a fitted contact lens that is not only comfortable to wear, but it is stable without the risk for spontaneous decentration or