Exchange of a posterior chamber phakic intraocular lens in a highly myopic eye

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ABSTRACT

A 38-year-old woman had posterior chamber phakic intraocular lens (IOL) implantation as a secondary refractive procedure to correct residual refraction (20/50 with −16.50 −1.50 × 80) in May 1998, 3 years after intrastromal corneal ring segment surgery for high myopia (−30.00 diopters). Ultrasound biomicroscopy revealed an oversized lens, leading to malpositioning. Moreover, the patient remained undercorrected (20/40 with −5.25 −0.75 × 120). Ten months later, the phakic IOL was uneventfully exchanged for a shorter one with the correct dioptric power. It was well placed in the posterior chamber. The patient's visual acuity was 20/30 with −2.25 −0.75 × 145, very close to the refraction in the fellow aphakic eye (20/30 with −2.50 −0.75 × 75). Patient satisfaction with the final visual outcome was high. Accurate ciliary sulcus measurement is critical for proper phakic IOL sizing. *J Cataract Refract Surg 2000; 26:773–776 © 2000 ASCRS and ESCRS*

Phakic intraocular lens (IOL) implantation is one of the hottest topics in refractive surgery. The Implantable Contact Lens™ (ICL) (Staar Surgical AG) is a posterior chamber phakic IOL made of flexible hydrophilic material from a porcine collagen/HEMA copolymer that can be folded and injected through a 3.0 mm self-sealing clear corneal incision under topical anesthesia. Five ICL lengths, ranging from 11.0 to 13.0 mm in 0.5 mm increments, are available for myopic eyes. Its implantation is becoming a familiar procedure, with promising results for the correction of refractive errors.[1]

The horizontal diameter of the limbus—white-to-white (WW) measurement—is an important element in sizing the ICL. In myopic eyes, the "golden rule" to determine the overall length (mm) of the ICL is obtained by adding 0.5 mm to the horizontal WW.[2]

The ICL size plays an important role, dictating the separation between the ICL and the natural lens. Thus, the ICL vault depends on the size of the phakic IOL. An oversized ICL will result in a greater distance between it and the crystalline lens, and the opposite will happen with an undersized ICL, which can even lead to unwanted contact between the ICL and the crystalline lens. Ultrasound biomicroscopy (UBM) can show the ICL and its relation to the adjacent structures in the posterior chamber.[3]

We report a case of ICL exchange because of malpositioning 10 months after the primary oversized ICL was implanted in a highly myopic eye that had had intrastromal corneal ring segment (ICRS) surgery.

Case Report

A 38-year-old woman with a history of extreme myopia in both eyes (−30.00 diopters [D]) had ICRS implantation in both eyes by another surgeon. In the right eye, the ICRS was

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implanted in 1994 and subsequently explanted. This eye later had clear lens extraction, which resulted in a best corrected visual acuity (BCVA) of 20/30 with −2.50 −0.75 × 75. In the left eye, the ICRS was implanted in 1995, but the eye was severely undercorrected, requiring −16.50 −1.50 × 80 to achieve a BCVA of 20/50. The patient was referred for ICL implantation as a secondary procedure to correct the significant residual myopia in the left eye, which had the following measurements: horizontal WW 12.0 mm; anterior chamber depth 3.06 mm; axial length 32.63 mm; lens thickness 4.35 mm; keratometry (K1/K2 in diopters) 39.50/40.50; intraocular pressure (IOP) 12.00 mm Hg. Three neodymium:YAG laser peripheral iridotomies were done at approximately 9, 11, and 2 o'clock meridians 11 days before the ICL implantation.

In May 1998, a 13.00 mm, −14.00 D ICL (version 2) was implanted uneventfully through a 3.0 mm clear corneal incision under topical anesthesia. The target refraction was a low myopia to balance with the refraction in the right eye. The postoperative course was unremarkable. However, UBM showed a marked separation (0.812 mm) between the ICL and the crystalline lens centrally. In the periphery, the ICL footplates displaced the ciliary processes backward, revealing an oversized phakic IOL (Figure 1). In addition, the ICL was tilted, with its lateral haptic pushing the iris forward. This significantly reduced the anterior chamber depth, especially in the area over the lateral haptic, without, however, compromising the IOP, which was normal.

The patient was disappointed with the visual outcome because of the undercorrection; the left eye was corrected to 20/40 with −5.25 −0.75 × 120. In March 1999, 10 months after ICL insertion, it was decided to exchange the oversized ICL to correct the malposition and minimize the undercorrection. A shorter (11.5 mm) ICL (version 2) with a higher power (−19.50 D) was implanted. Under topical anesthesia, the original clear corneal self-sealing incision was reopened; the oversized ICL was dislodged from the posterior chamber and easily explanted through the same unenlarged incision. A large amount of pigment was noticed on the front surface of the lateral haptic as a result of the contact between the IOL and the posterior surface of the iris (Figure 2). The new ICL was implanted in the usual fashion. The postoperative course was uneventful.

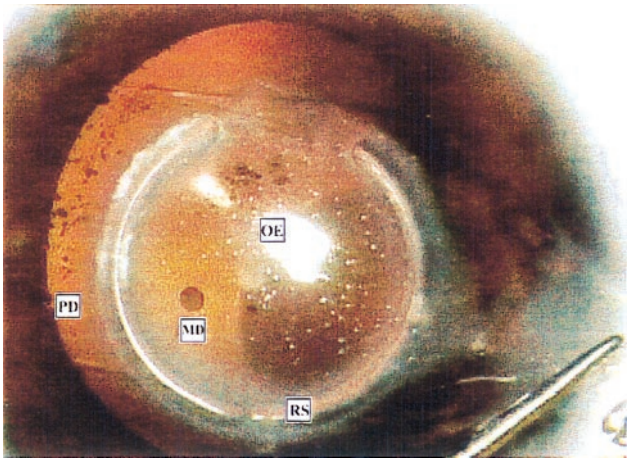

Figure 2. (Trindade) The ICL being explanted by a forceps. Note the pigmentary deposits (PD) on its surface, the ICL manipulation dimple (MD), the optic–haptic edge (OE), and the ring segments (RS).

Ultrasound biomicroscopy showed a well-positioned ICL with a central vault of 0.082 mm. The footplates were in the ciliary sulcus, and the anterior chamber was deeper (Figure 3). One month postoperatively, the BCVA was 20/30 with −2.25 −0.75 × 145; in the right eye, it did not change (20/30 with −2.50 −0.75 × 75). The patient was satisfied with the final visual outcome.

Discussion

Surgical correction of high myopia comprises several procedures. Currently, phakic IOL implantation, laser in situ keratomileusis (LASIK), and clear lens extraction are considered the best options. Zaldivar et al.[4] recently demonstrated the efficacy of combining ICL implantation and LASIK for extreme myopia and coined the term bioptics.

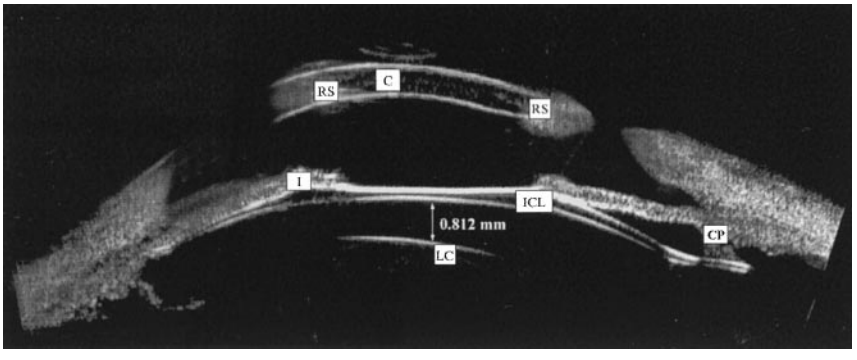

Figure 1. (Trindade) Composite UBM showing the oversized malpositioned ICL. The ICL is significantly vaulted, leaving a 0.812 mm separation (arrows) between it and the anterior crystalline lens capsule (LC). The ciliary processes (CP) are turned backward by the ICL footplate on the right. Note the long contact between the ICL and the iris (I) on the left. The ring segments (RS) are shown in the cornea (C).

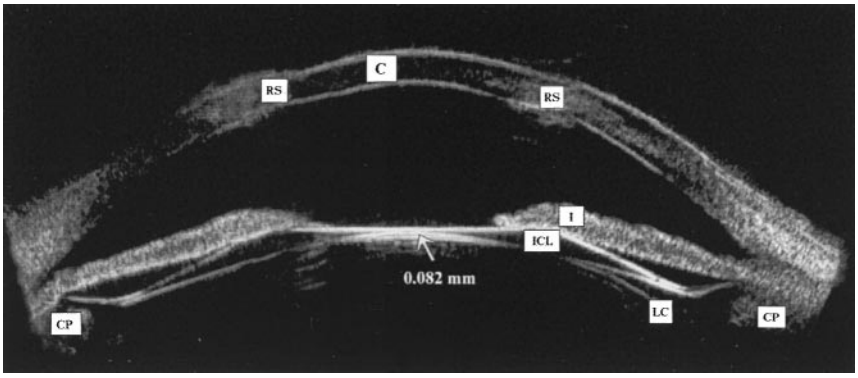

Figure 3. (Trindade) Composite UBM after ICL exchange. The haptics are positioned in the ciliary sulcus. The ciliary processes (CP) are in their usual orientation. The contact between the iris (I) and the ICL is markedly reduced, and there is a 0.082 mm separation (arrow) between the ICL and the anterior crystalline lens capsule (LC). The ring segments (RS) are shown in the cornea (C).

In the present case, 3 surgical procedures were done to correct myopia of −30.00 D. The original ICRS surgery resulted in severe undercorrection. Three years later, an ICL was implanted as a secondary procedure to correct the severe residual myopia, but it was oversized and malpositioned, with a remarkable central vault and considerable undercorrection. Ten months later, the ICL was uneventfully exchanged for a shorter and higher-powered one. Ultrasound biomicroscopy performed a month after the exchange showed a well-centered ICL, with a much smaller central vault and a deeper anterior chamber. The final refraction was close to that in the aphakic fellow eye, and the patient was satisfied.

The horizontal diameter of the limbus is considered an important element in determining ICL length. It is recommended that 0.5 mm be added to the horizontal WW in myopic eyes to obtain the ICL overall length.[2] Fechner,[5] however, suggests adding 1.0 mm to the WW so the larger ICL will be forced to buckle forward, increasing the distance between the artificial and natural lenses.

We previously reported that the axial ICL–lens distance varied from 0.035 to 0.255 mm (average 0.140 mm) with proper centration and adequate sizing of the phakic IOL.[3] The ICL lengths were obtained by adding 0.5 mm to the horizontal WW, as recommended by the lens manufacturer.[2] Despite the correct sizing, however, the ICL presumably touched the crystalline lens in the midperiphery in all cases but one. The thickest part of the ICL (approximately 0.300 mm)[3] is in this region at the optic–haptic junction. Unequivocal contact between the ICL and the crystalline lens is impossible to demonstrate because UBM has a resolution of 0.040 mm; that is, it cannot reveal a distance smaller than 0.040 mm.[6]

The ideal range of ICL axial vault is 0.300 to 0.600 mm.[7] Based on our UBM study about ICL positioning in highly myopic eyes,[3] it is unusual to observe such vaulting with lenses whose sizes were calculated by applying the recommended golden rule for myopic eyes[2]: ICL length (mm) = horizontal WW + 0.5.

Zaldivar et al.[4] state that low vaulting of the ICL may induce subcapsular cataract by mechanical irritation of the anterior lens capsule or by obstruction of aqueous circulation to the crystalline lens. In contrast, excessive vaulting may lead to iris chafing and pigment loss. An oversized ICL would lead to a greater vault, increasing the distance between the natural lens and the phakic lens, making contact between the 2 lenses highly unlikely. A greater vault would, however, increase the contact between the ICL and the posterior surface of the iris, raising concern about pigment dispersion and pigmentary glaucoma as a late complication. Pigmentary deposits have been observed in the optical zone and in the angle after ICL implantation (J.-L. Arne, MD, "ICL Performs Well in French Studies," EuroTimes, November–December 1998, page 7), which is of some concern since highly myopic eyes are by their nature at increased risk for developing glaucoma. In our case, a large number of pigment deposits were found on the front surface of the lateral haptic, where the oversized ICL pushed the iris forward markedly.

Thus, proper sizing of the ICL is very important because it dictates the distance between the ICL and the natural lens. Ultrasound biomicroscopy is useful in visualizing this. Ideally, the ICL should buckle forward to allow adequate space between it and the crystalline lens, but not enough to result in severe contact with the iris that could lead to late complications such as pigment dispersion and pigmentary glaucoma.

In myopic eyes, the addition of 0.5 mm to the horizontal WW results in good ICL centration, but separation between the ICL and the crystalline lens is observed only centrally in most cases. In the midperiphery, under the thickest part of the ICL (optic–haptic junction), contact with the crystalline lens is frequently revealed by UBM.[3] Therefore, it is advisable, as suggested by Fechner,[5] to add 1.0 mm instead of 0.5 mm to the horizontal WW to increase the distance between the artificial and natural lenses. Although this was done in our case, the lens was oversized and malpositioned, leading to excessive forward buckling. The exchange for a shorter lens was empirically indicated to avoid the enormous forward displacement. The exchange was uneventful and the refractive outcome successful.

Measurement of the horizontal WW is an indirect, not very accurate assessment of the ciliary sulcus diameter. Therefore, it may be misleading when used to calculate the ICL size. The more important element would be direct measurement of the ciliary sulcus diameter. The ciliary sulcus has an irregular contour, causing internal diameter variations.[8] Moreover, iridociliary cysts are common findings in UBM examinations and may influence the relative position of the ICL. Several authors report that the mean ciliary sulcus diameter ranges from 10.6 to 11.4 mm and that axial length is an important related variable.[9,10]

A more accurate way than the WW to measure the ciliary sulcus is needed to calculate the ICL size accurately and achieve optimal positioning of the phakic IOL in the posterior chamber. Current available methods have limitations. Ultrasound biomicroscopy provides only a 5.0 × 5.0 mm field. The UBM composite images could provide direct measurement of the ciliary sulcus, but they are subject to artifacts and may not be precise unless very careful scanning is done, ideally computer-guided scanning, which is not yet available. Scheimpflug analysis could also be of some use, although the iris prevents direct observation of the ciliary sulcus. Directly measuring the ciliary sulcus can be valuable in the crucial process of choosing the correct size of the posterior chamber phakic IOL, and the manufacturer should be able to customize the lens to meet the demands of the surgeon.

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