

Long-term follow-up of persistent low vault after implantable collamer lens exchange

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The implantable collamer lens (ICL) is a widely used posterior chamber phakic intraocular lens that achieves excellent refractive results. Nonetheless, serious postoperative complications related to inadequate vault have been previously reported. Therefore, lens exchange is advised when the vault is out of the recommended ranges. This article presents a case with persistent low vault after lens exchange in which no clinical evidence of crystalline lens opacity

or decrease in uncorrected distance visual acuity has been identified during the 6-year clinical follow-up performed to date. Therefore, this suggests that clinical follow-up could be an appropriate approach for patients presenting with low vault, especially those who are older than 40 years and have a history of lens exchange.

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Phakic intraocular lenses (IOLs) are an excellent refractive option for some patients who are not eligible for ophthalmic laser surgery, such as those presenting with high ametropia or thin corneas.¹ The implantable collamer lens (ICL)—a posterior chamber phakic IOL—is one of the most frequently used phakic IOLs.

Despite the relatively easy implantation technique and good refractive results—even in the long term²—achieved by ICL implantation, the calculation of its diameter could be problematic because although this lens is designed for sulcus implantation, measurement of sulcus-to-sulcus diameter is not accurate or predictable with the commonly available technology. Hence, the ICL calculator uses white-to-white (WTW) distance to calculate the lens diameter; however, it must be kept in mind that sulcus-to-sulcus and WTW measurements do not always have a predictable correlation, and that different devices have important WTW measurement variability.³

These obstacles for determining the precise lens diameter required by a given eye anatomy hinder the predictability of the lens vault, which is defined as the distance between the posterior surface of the ICL and the anterior capsule of the crystalline lens.⁴ When this distance is not accurate, problems during the postoperative period could arise, including cataract development when the vault is too low (because of the mechanical contact and the crystalline metabolism

disturbances) or increased intraocular pressure, pupillary block, acute glaucoma, and pigment dispersion when the vault is too high (because of the contact between the lens and the iris).¹

Although optimal refractive results and satisfied patients, from a visual point of view, are commonly found after ICL implantation, out-of-recommended-range lens vaults are also often identified. Under these circumstances, clinical decision-making is controversial because on one hand, proposing a lens exchange to a patient who is presently satisfied with the results is challenging because it implies an additional intraocular surgical procedure with its inherent risks; however, on the other hand, not exchanging the lens exposes the patient to possibly developing serious complications. At present, inadequate lens sizing is reported as the most common reason for ICL exchange,⁵ making it advisable to proceed with lens exchange when a vault less than 100 μm or more than 1000 μm is documented.⁶

The case presented in this article exposes a scenario in which closed clinical follow-up could be a valid decision despite a very low ICL–lens vault.

CASE REPORT

A 38-year-old woman, who previously had laser in situ keratomileusis to treat high myopia in the right eye and photorefractive keratectomy in the left eye, presented to our institution in 2011 to be assessed for alternative treatments to improve the visual acuity in the left eye. At that time, the patient's uncorrected distance visual

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acuity (UDVA) was 20/20 in the right eye and 20/400 in the left eye; and the left eye refraction was $-5.50 -1.00 \times 0$ with a corrected distance visual acuity of 20/20. Corneal tomography showed a pachymetry of 356 μm at the thinnest point. Considering the above, ICL (V4 model, ICM115V4, 11.5 mm, STAAR Surgical Co.) surgery was performed in the left eye, and no complications were reported.

After surgery, the patient was satisfied; she had a UDVA of 20/20 and normal intraocular pressure. However, multiple measurements during the first postoperative year showed a lens vault in the 80 to 100 μm range (Figure 1, A). Considering the risk-benefit ratio of such a low vault, the ICL was exchanged for a larger diameter ICL (V4 model, ICM120V4, 12.0 mm, STAAR Surgical Co.) 1 year after the initial surgery (Table 1). There were no surgery-related events, and the patient achieved a UDVA of 20/20 with a refraction of -0.25 sphere.

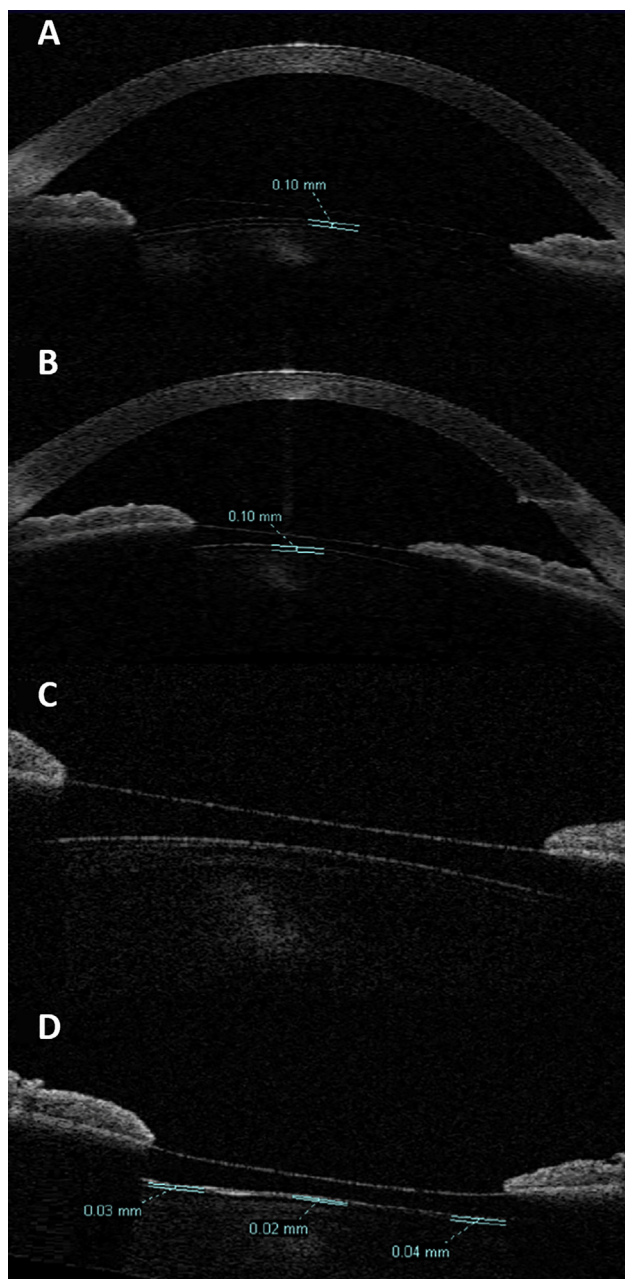


Figure 1. Anterior segment optical coherence tomography showing low vault. *A:* First surgery, postoperative period (10 months). *B:* Second surgery, early postoperative period (1 month). *C* and *D:* Second surgery, late postoperative period (6 years).

Table 1. Data used for ICL calculation.

Parameter	First Surgery	Exchange Surgery
Subjective refraction	$-5.50 = -1.00 \times 0$	$-5.50 = -1.00 \times 0$
Keratometry (D)*	40.5/42.1 $\times 0$	40.5/42.1 $\times 15$
Anterior chamber depth (mm)*	2.84	2.84
Thinnest pachymetry (mm)*	0.356	0.364
White-to-white (mm)*	11.1	11.5 [†]
Recommended ICL	ICM115V4 [‡]	ICM120V4 [‡]
Power	-8.0	-8.5
Diameter	11.5 mm	12.0 mm
Expected refraction	$-00.71 +00.92 \times 90$	$-00.38 +00.90 \times 92$

ICL = implantable collamer lens

*Scanning-slit corneal topography (Orbscan II, Bausch & Lomb, Inc.)

[†]0.4 mm added to the white-to-white used for the first ICL calculation

[‡]STAAR Surgical Co.

However, even with an increase of 0.5 mm in ICL sizing, the low vault persisted; this time with values between 80 μm and 120 μm during the first 2 postoperative months (Figure 1, B). At this point, two options were discussed with the patient: a new lens exchange or observation and clinical follow-up, and the patient agreed to the latter. Since then, clinical follow-up has been performed every 6 months over the past 6 years (the patient is now 45 years old), and despite a minimum lens vault, no evidence of cataract development (just minimal sclerosis attributable to age) has been identified (Figure 1, C and D, and Figure 2).

DISCUSSION

In the case herein presented, the initial decision to perform lens exchange was based on recommendations to achieve a higher vault⁶ and therefore reduce the risk for cataract development. However, this surgery resulted in a situation in which there were no clear recommendations because after the initial ICL exchange, the lens vault continued to be too low, and to propose a third intraocular surgery would have been discouraging for both the patient and the ophthalmologist.

After considering the pros and cons of possible treatments for this patient, a course of treatment consisting of clinical follow-up every 6 months was implemented based on the following reasons:

- (1) The achieved refractive result was optimal, and the patient was satisfied.
- (2) A patient with a history of high myopia who developed visually significant cataract after an ICL implantation is exposed to risks related to surgery, especially retinal detachment.⁷ However, our patient—a woman in her fourth decade with high myopia—might present early posterior vitreous detachment,⁸ after which the risk for retinal detachment is substantially decreased.^{9,10}
- (3) It has been previously reported that high myopic patients could develop cataract earlier¹¹; therefore, even if a new lens exchange were performed, the patient would probably have required cataract surgery in the midterm.

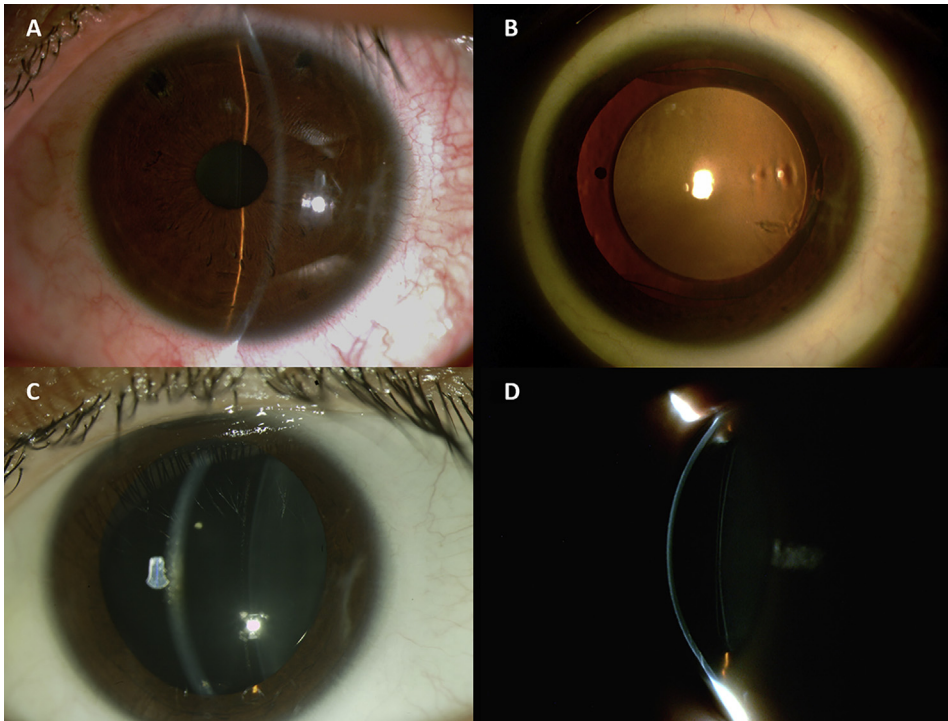


Figure 2. Slitlamp showing a general view of the anterior segment (A), the position of the implantable collamer lens under pharmacological mydriasis (B), and the absence of crystalline opacities (just minimal sclerosis attributable to age) (C and D).

- (4) A third intraocular surgery would lead to additional endothelial cells loss, a risk for endophthalmitis, and a risk for cataract secondary to surgical manipulation; moreover, accurate sizing could not be guaranteed.
- (5) Although it has been reported that vault values between ICL models V4 and V4c are comparable,¹² a third surgery would imply not only a change in lens diameter change, but also in lens model, which could lead to a greater probability of error.
- (6) The patient clearly understood the risks and benefits of each of the two options (second exchange or clinical follow-up), and voluntarily elected the second option.

During the 6-year follow-up performed to date, there has been no clinical evidence of crystalline lens opacity or a worsening in UDVA. As expected, the vault has decreased with the passing of the years, which has been previously shown to be attributable to crystalline physiologic growth.¹³

Importantly, this case suggests that when a patient has a low vault after an ICL implantation, and a lens exchange is being considered, it is relevant to consider not only the vault itself, but also the patient's age and previous history of ICL exchanges.

The age of the patient is a determinant because with increasing age, the patient would physiologically have less time without presenting with cataract; and if phacoemulsification is required, an older patient would have a higher risk because of the increased possibility of experiencing posterior vitreous detachment.

A previous history of lens exchange implies considering all the risks associated with a second intraocular surgery. In addition, it is also important to consider that if the

lens sizing were already inaccurate in two or more calculations, a third attempt would not guarantee precision, and on the contrary, there would be a greater possibility of encountering sizing problems. Moreover, topographic and biometric measurements could vary significantly after excimer laser treatments.

In conclusion, we propose that in patients—especially, those who are older than 40 years of age—who, despite having a previous lens exchange continue to exhibit low vault, clinical monitoring is a valid clinical approach, especially if the patient is satisfied with the results achieved at that point and agrees to this course of management.

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