

# IMPROVING SUCCESS WITH PHAKIC IOLS



ICL vault selection and long-term outcomes.

BY RENFENG “RENA” XU, MD, PHD, AND BEERAN MEGHPARA, MD

**VULT: VULT ACCURACY USING DEEP LEARNING TECHNOLOGY: NEW IMAGE-BASED ARTIFICIAL INTELLIGENCE MODEL FOR PREDICTING IMPLANTABLE COLLAMER LENS POSTOPERATIVE VULT**

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*Industry support for this study: None*

**ABSTRACT SUMMARY**

The goal of this retrospective machine learning study was to develop a deep learning model (DLM) to predict the postoperative vault of an EVO ICL (STAAR Surgical). The study included 437 eyes of 221 consecutive patients who underwent ICL implantation for myopia between 2022 and 2023. A DLM was trained on preoperative very high-frequency digital ultrasound images obtained with the ArcScan Insight 100 (ArcScan) of different ICL sizes (12.1, 12.6, and 13.2 mm), patient demographics, and postoperative vault. The mean absolute error (MAE) was used to quantify prediction performance. A

## STUDY IN BRIEF

► A retrospective machine learning study aimed to develop a deep learning model to predict the postoperative vault of an EVO ICL (STAAR Surgical).

## WHY IT MATTERS

Improper ICL sizing can lead to postoperative complications such as cataract formation, narrowing of the iridocorneal angle, and endothelial cell loss. Traditional methods of predicting the postoperative vault rely on white-to-white measurements and are susceptible to human error and variability. This study sought to enhance the precision of ICL sizing by leveraging the power of AI, particularly deep learning.

lower MAE indicated greater accuracy in predicting postoperative vault.

The DLM achieved an MAE of 66.3 μm with 100% of predictions for the 12.1-mm lens, 103 μm with 99% of predictions for the 12.6-mm lens, and 91.8 μm with 96.6% of predictions for the 13.2-mm lens, indicating a high level of accuracy in predicting postoperative vault. Because of the limited number of images, the DLM could not effectively predict the vault for the 13.7-mm lens.

## DISCUSSION

This study marks a significant step forward in ICL sizing with a purely image-based DLM that achieved a high level of accuracy in predicting postoperative ICL vault. The DLM overcame limitations of traditional methods such as variability in white-to-white measurements. Future research should focus on expanding datasets and refining the algorithm to enhance its generalizability.

**TEN-YEAR FOLLOW-UP OF POSTERIOR CHAMBER PHAKIC INTRAOCULAR LENS WITH CENTRAL PORT DESIGN IN PATIENTS WITH LOW AND NORMAL VULT**

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**ABSTRACT SUMMARY**

This retrospective comparative case series assessed clinical outcomes and postoperative complications

with the Visian ICL featuring a central port (model V4c; STAAR Surgical). Patients underwent ICL implantation between July 2011 and July 2012. The study included 127 eyes with 10 years of follow-up. Eyes were divided into two groups based on the vault 1 year after surgery: low (< 250 μm; n = 37) and normal (250–800 μm; n = 90).

During 10 years of follow-up, no differences in patients' uncorrected distance visual acuity, corrected distance visual acuity, or refraction were observed between groups. No patient developed an ICL-induced anterior subcapsular

opacity, and IOPs remained stable. An ICL exchange was required in two (5.4%) and eight (8.9%) eyes in the low- and normal-vault groups, respectively. Excimer laser ablation to correct a residual refractive error was required in one (2.8%) and two (2.2%) eyes in the low- and normal-vault groups, respectively. No pigment dispersion glaucoma or other vision-threatening complications were reported. A 3.8% and 4.5% loss in endothelial cell density at 10 years compared to preoperative levels was found in the low- and normal-vault groups, respectively ( $P = .4$ ).

## ▶ THE LITERATURE

## STUDY IN BRIEF

- ▶ A retrospective comparative case series with 10 years of follow-up evaluated clinical outcomes and postoperative complications with the Visian ICL featuring a central port (model V4c; STAAR Surgical). The central hole helped to prevent cataract formation even in eyes with a low vault.

## WHY IT MATTERS

The central hole design addresses complications associated with earlier ICL models, especially cataract formation in eyes with a low vault. The V4c model has been in use for more than a decade. Emerging long-term data are crucial to evaluating its efficacy and safety.

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## DISCUSSION

The addition of a central hole has increased the long-term safety and efficacy of the V4c model compared to earlier iterations of the ICL. This study's results indicate that the hole effectively mitigates the risk of cataract formation, even in eyes with a low vault. The dynamic flow of aqueous humor through the central hole likely facilitates a more physiologic environment that reduces the mechanical and metabolic

factors that have contributed to cataract development with earlier ICL models.

The reduced incidence of cataracts, stable IOP, minimal change in endothelial cell density, and sustained visual outcomes over 10 years suggest that the V4c model is a reliable option for patients seeking long-term refractive correction. Future research with longer follow-up periods is required to confirm these findings and increase physicians' understanding of the benefits of the central hole design. Additionally, more

data are required to determine whether nuclear and posterior subcapsular cataract formation can be attributed to the ICL. ■

1. Nasser T, Hirabayashi M, Virdi G, Abramson A, Parkhurst G. VAULT: vault accuracy using deep learning technology: new image-based artificial intelligence model for predicting Implantable Collamer Lens postoperative vault. *J Cataract Refract Surg.* 2024;50(5):448-452.
2. Alfonso-Bartolozzi B, Fernández-Vega-Cueto L, Lisa C, Palacios A, Madrid-Costa D, Alfonso JF. Ten-year follow-up of posterior chamber phakic intraocular lens with central port design in patients with low and normal vault. *J Cataract Refract Surg.* 2024;50(5):441-447.

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