Long-term ultrasound biomicroscopy observation of position changes of a copolymer posterior chamber phakic intraocular lens

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PURPOSE: To evaluate longitudinal changes in Implantable Collamer Lens phakic intraocular lens (pIOL) position after implantation.

SETTING: Department of Ophthalmology, Zhejiang University, Hangzhou, China.

DESIGN: Retrospective case series.

METHODS: Myopic eyes that had pIOL implantation with a follow-up of at least 24 months were evaluated. Ultrasound biomicroscopy examinations were performed at each visit.

RESULTS: The study enrolled 62 eyes (31 patients; 22 women, 9 men) ranging in age from 21 to 46 years. The manifest spherical equivalent ranged from −8.25 to −18.75 diopters. A significant increase (mean 36 μm ± 50 [SD]) in the endothelium–anterior pIOL distance occurred between 1 month and 3 months (P=.000); afterward, the distance decreased slowly (P>.05). The largest decrease (mean 47 ± 17 μm) in central vault occurred between 1 month and 3 months (P=.009). The largest decrease (mean 21 ± 14 μm) in peripheral vault occurred between 1 month and 3 months (P=.000).

CONCLUSIONS: A significant increase in the endothelium–anterior pIOL distance occurred from 1 month to 3 months postoperatively, after which a slight decrease occurred over time. Central vault and peripheral vault had a tendency to decrease over time.

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The Visian Implantable Collamer Lens (Staar Surgical Co.) is a foldable phakic intraocular lens (pIOL) designed to be placed in the posterior chamber behind the iris with the haptic zone resting on the ciliary sulcus.[1] To prevent damage to intraocular tissues and achieve a stable refractive outcome, pIOLs must maintain a safe distance from the corneal endothelium and the crystalline lens.[2] A pIOL is more likely to come in contact with the crystalline lens in the peripheral area as a result of the pIOL's design, which tends to be thicker at the optic–haptic junction.[3] The leads to an increased risk for cataract formation. These factors make clinical assessment of peripheral vault and long-term follow-up an important part in the evaluation of safety of pIOL implantation. However, the long-term, accurate behavior of peripheral vault has not been fully elucidated.

Ultrasound biomicroscopy (UBM) is the most ideal method for visualizing peripheral vault because anterior segment optical coherence tomography and other optical devices are not able to penetrate the iris pigment epithelium; thus, they cannot evaluate the structures behind the iris.[4] The purpose of the present study was to use UBM to evaluate longitudinal changes in central vault, peripheral vault, and the endothelium–anterior pIOL distance in patients with pIOLs.

PATIENTS AND METHODS

All eyes in this study had implantation of a pIOL (ICL V4 model) for myopia by the same surgeon (Y.S.) at the

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Department of Ophthalmology, First Affiliated Hospital, College of Medicine, Zhejiang University, from December 2008 to September 2010. At the time of surgery, patients were fully informed of the details and possible risks of the surgical procedure. All patients provided written informed consent before surgery in accordance with the tenets of the Declaration of Helsinki. The university's ethics committee approved the study.

The inclusion criteria for pIOL implantation were age between 21 years and 45 years, stable refraction, corneal astigmatism lower than 1.00 diopter (D), a clear lens, and at least 24 months of follow-up. Exclusion criteria were keratoconus, refractive surgery, glaucoma, cataract, uveitis, synechiae, anterior chamber depth (ACD) less than 2.8 mm, and angle depth less than grade II (20 degrees) by the Spaeth grading system.[5,6]

Preoperative Examination and Phakic Intraocular Lens Power

The preoperative examination included visual acuity, manifest and cycloplegic refractions, keratometry, corneal topography, pachymetry using scanning-slit corneal topography (Orbscan II, Bausch & Lomb), endothelial cell count (ECC), A-scan ultrasonography, slitlamp microscopy, applanation tonometry, and dilated indirect fundoscopy. The pIOL diameter was individually determined based on the horizontal white-to-white (WTW) distance and the ACD measured with the scanning-slit corneal topography system following the manufacturer's recommendations (ie, adding 0.5 mm or 1.0 mm to WTW depending on the ACD). Power calculation for the pIOL was performed using the software provided by the pIOL manufacturer and a modified vertex formula.[7]

Surgical Technique

Preoperatively, 2 peripheral iridectomies were created with a neodymium:YAG laser. The surgical technique has been described in detail.[8]

Follow-up

Postoperative examinations were scheduled at 1 day, 1 week, and 1, 3, 6, 12, 18, and 24 months. The evaluations included visual acuity, manifest refraction, applanation tonometry, ECC, slitlamp microscopy, and UBM.

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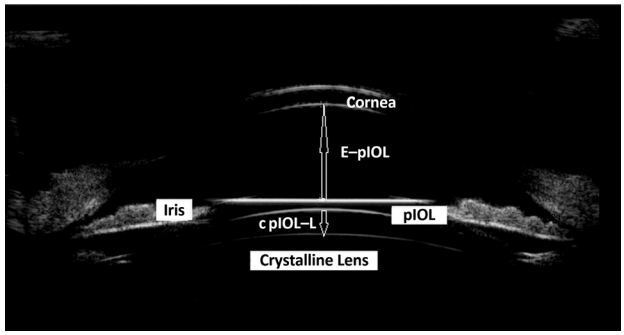

Figure 1. Ultrasound biomicroscopy image of the central section at the horizontal meridian showing the distance from endothelium to the anterior surface of the pIOL (E–pIOL) (*upward arrow*) and the central distance from the pIOL to the crystalline lens (c pIOL–L) (*downward arrow*) (pIOL = phakic intraocular lens).

Ultrasound Biomicroscopy

Ultrasound biomicroscopy was performed by the same examiner (Y.W.) using the SW-3200L full-scale 50 MHz digital system (Tianjin Suowei Electronic Technology Co. Ltd.). All patients were scanned in the supine decubitus position under standard illumination with nonaccommodation. Topical anesthesia of oxybuprocaine hydrochloride 0.4% was administered, and an eyecup filled with sterile normal saline was used. The patient was asked to fixate on a target located on the ceiling with the fellow eye to maintain fixation. For central measurements, a central section of the anterior chamber was taken through the corneal apex. It was centered on the pupil and included the pIOL and the anterior crystalline lens surface.[4]

As described by Du et al.,[4] the following parameters were obtained from each examination with the calipers provided by the manufacturer[9,10]:

1. *Endothelium–anterior pIOL distance.* This distance was measured between the first reflection of the ultrasound (US) between the aqueous humor and the corneal endothelium and the first reflection of the pIOL surface at the horizontal meridians of the central section (Figure 1).
2. *Central vault.* This measurement comprised the central distances at the horizontal meridians between the posterior reflection of the pIOL and the first reflection of the crystalline lens surface within a 1.0 mm radius from the pupillary center (Figure 1).
3. *Peripheral vault.* This measurement was obtained along the major axis on which the bilateral haptic footplates were located at the temporal sulcus and nasal sulcus. To perform the measurements, a line was drawn from the scleral spur parallel to the pupillary margin of iris and a perpendicular line was drawn through the midpoint. By following this last line, the measurement was performed between the final reflection of the US from the pIOL and the first reflection from the anterior capsule of the crystalline lens (Figure 2).

Statistical Analysis

Statistical analysis was performed using SPSS software (version 16.0, SPSS, Inc.). Descriptive statistics were obtained. Visual acuity changes postoperatively were