

Microphakinit and Microincisional IOLs

The evolution of the necessary lens technology continues.

BY AMAR AGARWAL, MS, FRCS, FRCOPHTH

The first microincisional IOL was developed by Acri.Tec (Berlin, Germany) with the assistance of Christine Kreiner and was implanted by A. John Kanellopoulos, MD, of Athens, Greece, in the year 2000. Wayne Callahan of Thinoptx (Abingdon, VA) designed a special rollable lens, which used a Fresnel principle. Jairo Hoyos, MD, from Barcelona, Spain, implanted the first ultrathin lens. I then modified it into a special 5-mm-optic rollable IOL.¹⁻¹⁹

On May 21, 2005, I used a 0.7-mm phaco needle tip with a 0.7-mm irrigating chopper for the first time to remove cataracts through the smallest incision possible. This technique is called *microphakinit* (Figure 1) and was developed with the help of Larry Laks from Microsurgical Technology (Redmond, WA), which manufactured the instruments. The challenge at present is the need for the IOL to pass through sub-1-mm incisions.

THINOPTX ULTRACHOICE 1.0

Thinoptx has patented technology that allows the manufacture of IOLs that are 100 μ m thick with ± 30.00 D of correction, so they may be implanted through incisions smaller than 1.5mm. The hydrophilic lens can be inserted using a special injector, which rolls and injects the IOL. The surgeon can then move the lens into the capsular bag. The natural warmth of the eye causes the lens to open gradually (Figure 2).

The Ultrachoice 1.0 (not available in the US) is manufactured to eliminate most spherical aberrations. Each

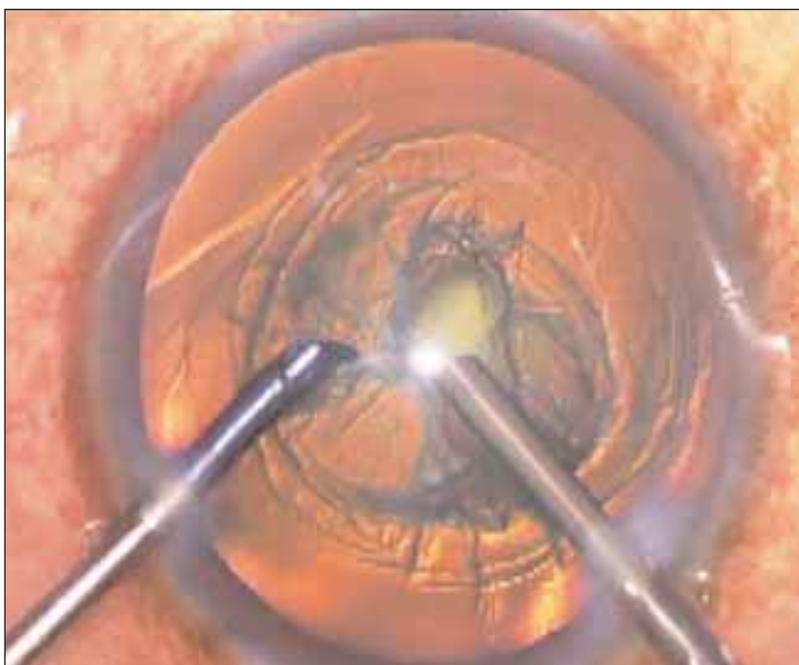


Figure 1. During microphakinit, the surgeon uses the 0.7-mm irrigating chopper and the 0.7-mm phaco tip (Microsurgical Technology) without the sleeve inside the eye. The assistant continuously irrigates the phaco-probe area from the outside to prevent corneal burns.

curve on its back has a slightly different radius. The small change in curvature on each back surface will ensure one focal point. With this technology, each ring has an exposed edge of 50 μ m or less. This diffractive implant is only 100 μ m thick with a range of correction from -25.00 to +25.00D. The second surface of the Ultrachoice 1.0 is designed to assist the front surface in focusing the light at a single point, which by definition is a refractive lens.

A form of aberration occurs due to light rays' traveling longer in the thicker portion of the lens. The error is additive to spherical aberrations, but it is small if the lens manufacturer controls the lens' thickness or compensates for the

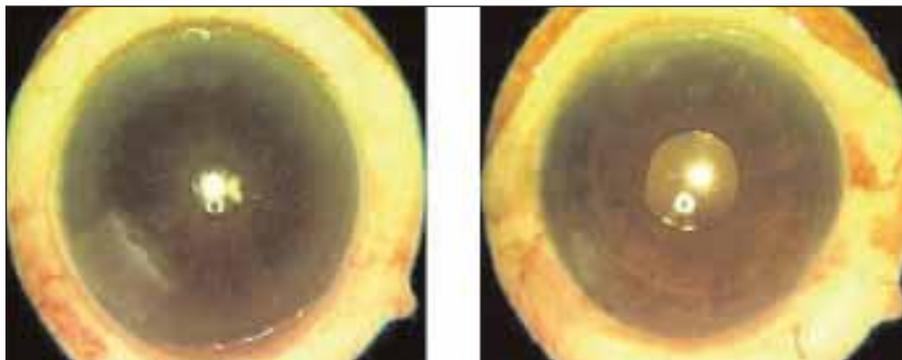


Figure 2. The surgeon performs phacoemulsification with a foldable IOL (left) and phakonit with an Ultrachoice 1.0 rollable IOL (right).

differences in thickness when measuring the lens. The error is not as much from the IOL's thickness as the fact that most lens benches are calibrated using the back focal length of the lens. A corrective factor for thickness is added to determine the lens power. The bench should be calibrated even with the same lens power if the lens' thickness changes significantly. The Ultrachoice 1.0 is so thin that the error is negated. With a central axis thickness of 50µm for a meniscus lens and 300µm for a biconvex or plano optic, there is little error in measuring the lens due to thickness.

ACRI.TEC IOLs

The single-piece foldable Acri.Lyc IOL (Acri.Tec; not available in the US) is composed of highly purified biocompatible hydrophobic acrylate with a chemically bonded UV-absorber. This IOL's cartridge is not inserted inside the anterior chamber but rather kept at the tip of the incision through which the lens is then inserted.

“Although microphakonit allows sub-1-mm cataract surgery, the hurdle of creating an IOL to fit through the same incision remains.”

The Acri.Smart IOL (Acri.Tec; not available in the US) is a one-piece, hydrophobic acrylic lens with a water content of 25%. It is stored in balanced salt solution to facilitate its implantation. The high purity of the lens material (which is exposed to a specific cleaning process), the excellent surface design, and the sharp edge design significantly decrease secondary cataract formation.

CLINICAL EXPERIENCE

My colleagues and I have routinely implanted Acri.Tec IOLs and have also worked with the special 5-mm-optic

Thinoptx rollable IOL. Jorge Alió, MD,^{20,21} of Alicante, Spain, implanted 46 eyes with the Acri.Smart IOL. He inserted the lens through a mean incisional size of 1.5 ±0.3mm (SD).

Patients' mean uncorrected distance visual acuity improved significantly from 20/100 (0.2 ±0.2 decimal value) preoperatively to 20/32 (0.7 ±0.3) by the end of 6 months postoperatively (*P*<.000). Subjects' best-corrected

distance visual acuity improved significantly from 20/50 (0.4 ±0.2) preoperatively to 20/25 (0.9 ±0.2) after 6 months (*P*<.000). The uncorrected near visual acuity at the end of 6 months was 20/32 (0.6 ±0.2, *P*<.000). The mean postoperative spherical equivalent was 1.10 ±0.90D (*P*<.947).

The safety index was 2.5 for distance and 1.4 for near. There were no intraoperative or postoperative complications. No eye required an Nd:YAG laser capsulotomy for posterior capsular opacification, and no patient reported undesirable complications at the end of 6 months.

Dr. Alió also evaluated the modulation transfer function in eyes implanted with a conventional IOL and two IOLs designed for microincisional cataract surgery. His prospective, nonrandomized consecutive series comprised 30 eyes implanted with one of the following IOLs: a conventional, foldable acrylic lens (Acrysof MA60BM; Alcon Laboratories, Inc., Fort Worth, TX); the Ultrachoice 1.0 (Thinoptx); or the Acri.Smart 48S. The 0.5 and 0.1 modulation transfer functions following microincisional cataract surgery were calculated 3 months after implantation with the Optical Quality Analysis System for a 5-mm pupil. The differences were statistically analyzed with the Mann-Whitney U test.

The values of 0.5 modulation transfer function for the Acrysof, Ultrachoice 1.0, and Acri.Smart IOLs were 2.647 cycles per degree (cpd) ±0.833 (SD), 2.601 ±0.986 cpd, and 3.453 ±0.778 cpd, respectively. The mean 0.1 modulation transfer function values for the same IOLs were 8.720 ±3.074 cpd, 8.814 ±4.380 cpd, and 11.418 ±2.574 cpd, respectively. Statistical analysis did not show significant differences in 0.5 and 0.1 modulation transfer function between the conventional and microincisional IOLs.

THE FINAL FRONTIER

Although microphakonit allows sub-1-mm cataract surgery, the hurdle of creating an IOL to fit through the

CATARACT SURGERY

FOCUS ON IOLs FOR MICROINCISIONS

same incision remains. According to an e-mail to me from Wayne Callahan of Thinoptx on December 22, 2005, work continues on a 26% material lens, which will be the forerunner of the sub-1-mm lens. Because such a lens must be extremely thin, its optical zone must be protected to avoid warping inside the eye. ■

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