Refractive outcomes of a single-piece hydrophobic aspheric intraocular lens implanted following cataract surgery

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The efficacy and refractive outcomes of a soft hydrophobic acrylic single-piece aspheric monofocal intraocular lens (IOL) (model 302AC, Millenium Biomedical, Inc.) following cataract surgery have not been reported. We performed a study to evaluate and report the refractive outcomes of this IOL.

PATIENTS AND METHODS

This was a prospective consecutive single-surgeon case series. Eyes with noncataract ocular comorbidities that could impede optimal postoperative outcomes were excluded from the study. Patient informed consent was obtained, and the study conducted in accordance with the tenets of the Declaration of Helsinki.

All patients had comprehensive baseline ophthalmic assessment and cataract workup including keratometry and biometry (IOLMaster 500, Carl Zeiss Meditec AG) measurements. Intraocular lens calculation was performed with third-generation IOL formulas (SRK/T, Hoffer Q, and Holladay). All surgeries were performed by a single surgeon (P.S.) in 1 location under topical anesthesia. The standardized phacoemulsification technique was performed with a 2.2 mm main corneal incision superiorly and a single side-port incision temporally. The preloaded IOL was implanted with a disposable injector (Mini Glider, MDJ). A topical nonsteroidal drug (ketorolac 0.5%) was started 2 days preoperatively, followed by a steroid (dexamethasone 0.1%) and antibiotics (chloramphenicol 0.5%) postoperatively; all were administered 4 times a day for a total of 4 weeks.

The primary outcome was the spherical equivalent (SE) within 0.25 diopter (D), 0.50 D, and 1.00 D of the refractive target.

RESULTS

Cataract surgery was performed in 152 eyes of 109 patients. The postoperative refractive outcomes were measured 5 weeks postoperatively. The mean preoperative keratometry and biometry measurements are summarized in Table 1. The mean predicted SE refractive target, the postoperative refractive outcome (SE), the mean refractive error from the predicted target (difference between target and SE outcome), and the mean absolute refractive error (MAE) are summarized in Table 2.

Table 1. Preoperative biometry.

Measurement	Mean ± SD
Nominal lens power (diopter)	22.17 ± 2.88
Anterior chamber depth (mm)	3.21 ± 0.32
Axial length (mm)	23.57 ± 1.08
Preoperative K1	7.82 ± 0.30
Preoperative K2	7.72 ± 0.29

K = keratometry

Table 2. Postoperative refractive data.

Measurement	Mean ± SD
Postoperative sphere	−0.65 ± 0.85
Postoperative cylinder	−0.33 ± 0.33
Predicted refraction (target) (Holladay 2)	−0.98 ± 0.82
Postoperative refractive outcome (SE)	−0.83 ± 0.86
Mean error from predicted (SE − target)	0.16 ± 0.45
Mean absolute refractive error	0.36 ± 0.30
Within ±0.25 D (%)*	45.4
Within ±0.50 D (%)	73.68
Within ±1.00 D (%)	96.05
Within ±1.50 D (%)	99.34
Within ±2.00 D (%)	100

SE = spherical equivalent
*Eyes within distance of target

DISCUSSION

We present the results from what we believe to be the first independent study assessing the refractive outcomes of the 302AC IOL following cataract surgery. Our data show that the IOL was reliable and able to achieve an MAE within 0.36 ± 0.3 D. Postoperative refractive outcomes were comparable to findings in both toric[1] and nontoric[2] IOL studies. The refractive outcomes were superior to those in some toric IOL studies (0.5 D, Xiao et al.[3]; 0.55 D, Mencucci et al.[4]), likely due to higher astigmatic error. The availability of an injector with preloaded IOLs was desirable due to convenience and reduced astigmatism from smaller wound incisions.

Our study was limited by the lack of a comparative cohort and a short postoperative follow-up. Further trials with longer follow-up that compare different monofocal IOLs or compare them with multifocal IOLs are warranted. Overall, the refractive outcomes of monofocal IOLs are underreported in the literature. Given that monofocal aspheric IOLs represent the majority of IOLs implanted, our clinical data may help surgeons assess the reliability of these IOLs among the wide range of available IOLs.

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First implantation of a diffractive quadrafocal (trifocal) intraocular lens

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Recent advances in intraocular lens (IOL) technology have led to the development of trifocal IOLs for presbyopia correction after lens removal. Our personal experience of more than 500 trifocal implantations (AT Lisa tri 839MP and AT Lisa tri toric 939MP, Carl Zeiss Meditec AG) with good visual acuity (0.1 logMAR or better) at far, intermediate, and near distance; high patient satisfaction despite some optical phenomenon; and high spectacle independence have led us to shift from bifocality toward trifocality for intraocular presbyopia correction.[1] It seems that this technology is still changing and improving. On July 3, 2015, I performed the first worldwide quadrafocal in-the-capsule IOL implantation through a 2.2 mm clear corneal incision at the Department of Ophthalmology, Goethe University, Frankfurt, Germany (Figure 1, *A*). Because this is new IOL technology, I thought the experience might be of interest to my fellow ophthalmologists in a short communication.

The Acrysof IQ Panoptix (Alcon Surgical, Inc.) is a quadrafocal IOL; however, in terms of function, it acts as a trifocal IOL. This 1-piece aspheric hydrophobic IOL has a blue filter and can be considered unique based on the optical effect principle it uses. Like all multifocal IOLs, it focuses crisply on multiple foci. To do this, the IOL has a 6.0 mm optical zone composed of a 4.5 mm large diffractive area in the center with 15 diffractive zones (Figure 1, *B*) and an outer refractive rim. The size of the diffractive optical zone should offer good near and intermediate visual acuity, even with dilated pupils, and be less dependent on pupil size. Light should be distributed with 25% to near and intermediate each and 50% for far vision. The IOL should also create a fourth focal point at 1.20 m (quadrafocal technology) (Figure 2). However, this does not mean a new focal point becomes accessible to the patient. Instead, the light from the first focal point is diffracted to the distance focus ("enlighten optical technology") of the IOL, leading to a more natural transition from near to intermediate to distance ranges with improved visual outcomes, which should give the IOL higher light efficiency, up to 88% compared with other multifocal IOLs such as the Restor +3.0 D (Alcon Surgical, Inc.) (84%) or traditional trifocal IOLs (81% to 82%) at 3.0 mm.[2–4] Like the other trifocal IOLs, this new IOL delivers 3 focal points as follows: near at approximately 40 cm, in the intermediate range at approximately 60 cm (other trifocal IOLs at 80 cm), and at the distance range. Because most work is performed at arm's length (60 to 70 cm), the new IOL, by shifting the intermediate focal point from 80 cm to 60 cm, aims to provide greater initial acceptance and patient satisfaction by making near and intermediate vision more comfortable.

Our first 4 patients confirmed the high initial acceptance rates and good visual outcomes with their visual acuity results, supporting the theoretical defocus curve. The first patient was very satisfied with the initial outcomes and commented, "I saw well immediately after removing the eye patch and could read."

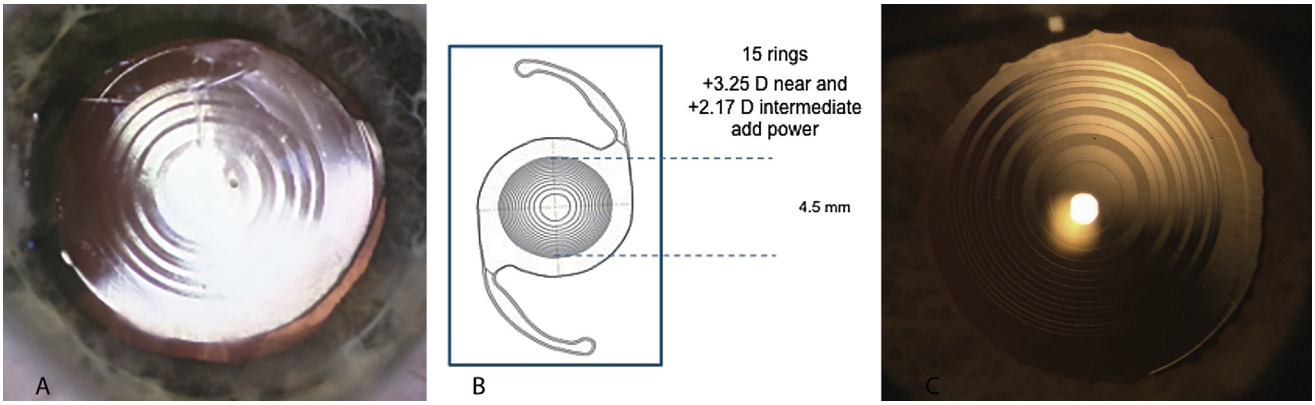

Figure 1. *A*: Intraoperative image of the first implantation of the diffractive quadrafocal IOL worldwide. *B*: Schematic drawing of the IOL. *C*: Postoperative slitlamp image of the first implanted IOL (*courtesy of Alcon*).