Successful visual rehabilitation after unilateral extended range-of-vision intraocular lens implantation in a patient with previous LASIK

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A case of a 44-year-old man undergoing cataract surgery because of ocular trauma in his right eye in which a nondiffractive continuous extended range-of-vision intraocular lens (IOL) was implanted is described. Uneventful bilateral myopic laser in situ keratomileusis correction had been performed 13 years before (oblate corneal profile). At 3 months postoperatively, uncorrected distance, intermediate, and near visual acuities were 0.10, 0.10, and 0.20 logMAR, respectively. An improvement was also observed in most of the subscales of the Visual Functioning Questionnaire-25, with the largest improvement in the subscales driving, distance activities, and general vision. Light distortion indices of 10.19% and 3.82% were found in the right and left eyes, respectively. This case shows that the unilateral implantation of this type of IOL can be a good solution in eyes with previous myopic corneal laser refractive surgery when monocular cataract surgery is needed, allowing a successful binocular visual restoration.

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The implantation of multifocal intraocular lenses (IOLs) in young patients undergoing cataract surgery has been shown to provide a satisfactory visual outcome, with a tolerable binocular summation for different viewing distances. However, this visual rehabilitation results are more complicated if the patient had undergone a previous corneal surgery, generating a significantly oblate corneal profile and an increase in higher-order aberrations. New presbyopia-correcting IOLs, such as extended depth-of-focus (EDoF) IOLs, have been suggested to be a good option to restore the visual function in eyes with previous laser in situ keratomileusis (LASIK) surgery, although considering the level of corneal higher-order aberrations and the IOL design and trying to match them. Indeed, the use of distant-dominant multifocal IOLs has been demonstrated that it is not contraindicated in cases with a history of previous LASIK. The case presented shows a successful binocular visual restoration in a young patient with a previous LASIK surgery undergoing unilateral cataract surgery with implantation of a new non-diffractive continuous extended range-of-vision IOL.

CASE REPORT

A 44-year-old man presented to the authors’ clinic for cataract surgery in his right eye. He had an intraocular traumatic injury in this eye when he was a child that was successfully treated but resulted in mild amblyopia and the development of cataract as a sequela. The patient had undergone bilateral LASIK surgery 13 years before (right eye −4.25 −1.75 × 140: 0.2 logMAR; left eye +0.50 −1.75 × 80: 0.0 logMAR), obtaining a successful visual outcome. Clinical reports provided by the patient showed that the right eye presented amblyopia, with a corrected distance visual acuity (CDVA) of 0.2 logMAR. Similarly, the patient referred worse vision in this eye since infancy. Informed consent was obtained according to standard cataract surgery, and an additional consent was provided by the patient to disseminate his results to the scientific community.

On examination, the patient presented uncorrected distance visual acuity (UDVA) of 1.30 and 0.00 logMAR in the right and left eyes, respectively. Similarly, a value of 1.0 logMAR was obtained in right eye for CDVA, distance-corrected intermediate visual acuity (measured at 66 cm),
and uncorrected (UNVA) and distance-corrected near visual acuity (measured at 40 cm). Uncorrected intermediate visual acuity (UIVA) measured at 66 cm in right eye was 1.30 logMAR. A corneal topographic examination was performed with a Placido disk–dual Scheimpflug imaging system (Galilei, Ziemer Ophthalmic Systems AG) in both eyes. An oblate shape was present in both eyes, with a mean keratometry of 41.54 diopters (D) and 43.83 D in the right and left eyes, respectively (Figure 1). The mean pachymetry was 533 μm and 549 μm, anterior corneal eccentricity was −0.28 and 0.43, and the mean value of the anterior corneal astigmatism was 1.22 D and 0.94 D in the right and left eyes, respectively. For a 6 mm pupil, the corneal primary spherical aberration was positive in the right eye, with a value of 0.44 μm. In the left eye, a value of 0.09 μm was measured for this aberrometric parameter. Besides these tests, biometry (axial length 25.01 mm; anterior chamber depth 3.33 mm), corneal endothelial count, and macular integrity examination by means of optical coherence tomography were also performed. In addition, the visual function was evaluated by means of a Visual Functioning Questionnaire-25 (VFQ-25).

The ASCRS IOL calculator for postoperative myopic refractive surgery (http://iolcalc.ascrs.org/) was used. According to this calculator, an IOL (model DFT015) power of 20.00 D was selected to be implanted assuming a target refraction of zero. Considering the patient had undergone previous refractive surgery generating an oblate corneal shape with induction of positive spherical aberration, a nondiffractive continuous extended range-of-vision IOL was implanted. Specifically, the AcrySof IQ Vivity IOL (Alcon Laboratories, Inc.) was successfully implanted after standard phacoemulsification surgery without the occurrence of any intraoperative complication. This IOL is a single-piece hydrophobic acrylic IOL with an overall diameter of 13.0 mm and an optic zone of 6.0 mm diameter. It uses a central 2.2 mm optical zone containing 2 non-diffractive transition elements that is beam shaped (X-Wave Technology), changing the wavefront of these central light beams to elongate the depth of focus. The anterior surface of the IOL is also designed with negative spherical aberration to compensate for the positive spherical aberration of the cornea. No zonular dialysis, iris trauma, or other was found during surgery. These findings would have modified IOL strategy.

One week postoperatively, UDVA, UIVA (66 cm), and UNVA (40 cm) were 0.10, 0.20, and 0.20 logMAR, respectively, in the right eye, whereas in the nonoperated eye, these 3 measures of visual acuity were 0.00 logMAR. Binocularly, UDVA, UIVA, and UNVA were 0.00 logMAR. Residual spherocylindrical refraction was +0.25 −0.50 × 180 degrees in the right eye but generating a minimal visual improvement (CDVA 0.10 logMAR, distance-corrected intermediate visual acuity 0.20 logMAR; and distance-corrected near visual acuity 0.20 logMAR), which was maintained during the follow-up. Patient’s satisfaction was remarkably high, showing a good visual integration with the contralateral eye that still had an active accommodative function.

At 3 months postoperatively, UDVA in the right eye was 0.10 logMAR, with improvement of UIVA to 0.10 logMAR. UNVA in the right eye remained stable, with a value of 0.20 logMAR. Distance contrast sensitivity thresholds measured with the Pelli-Robson test under photopic conditions were 1.35 log units in the right and left eyes, decreasing to 1.20 log units when measured under scotopic conditions.

Figure 1. Corneal topographic and aberrometric examination with a Placido disk–dual Scheimpflug imaging system (Galilei, Ziemer Ophthalmic Systems AG) in the right eye of the case report described. Different maps and data are displayed, which are identified with the corresponding title (anterior instantaneous curvature, corneal pachymetry, anterior elevation BFS, posterior elevation BFS, total corneal wavefront, etc.). BFS = best-fit sphere.
Besides visual acuity and quality of vision, the visual function-related quality of life was evaluated with the Spanish version of the validated questionnaire VFQ-25 preoperatively and at 3 months postoperatively. The results are displayed in Figure 2. As shown, improvement was observed in most of the subscales of the questionnaire, with larger improvement in magnitude in the scorings corresponding to the subscales driving, distance activities, and general vision. Similarly, the patient referred subjectively a mild nondisturbing perception of glare, with no perception of halos or starbursts. Finally, the Light Disturbance Analyzer (CEORlab, University of Minho) was used to characterize the level of light distortion postoperatively in both eyes (Figure 3), obtaining distortion indices of 10.19%, 3.82%, and 3.5% in the right eye, in the left eye, and under binocular conditions, respectively. No capsular phimosis or posterior capsule opacification was detected at the 3-month visit.

**DISCUSSION**

Some studies have demonstrated that the use of multifocal IOLs in eyes with previous myopic LASIK can result in good refractive results. Vrijman et al. demonstrated in a retrospective cohort study that cataract surgery with implantation of a hybrid refractive–diffractive multifocal IOL in eyes with previous corneal refractive laser surgery was effective and predictable, leading to successful visual restoration for a wide range of distances. However, less predictable outcomes were found in those eyes with previous surgeries for the correction of myopia of 6.00 D or higher mainly because of inaccuracies in IOL power calculations. Alfonso et al. demonstrated that good distance and near visual acuities could be obtained in post-myopic LASIK eyes undergoing cataract surgery with implantation of 2 different types of multifocal IOLs (bifocal diffractive IOL vs hybrid refractive–diffractive IOL), confirming the viability of this type of implants in such cases. Similarly, a case of postoperative above-average defocus curves in photopic and mesopic vision was reported in one patient with previous bilateral myopic LASIK undergoing cataract surgery with the implantation of a specific model of diffractive trifocal IOL, a finding mainly promoted by aberrometric compensation between the modified corneal shape after LASIK and the specific optics of the IOL. However, despite all these good visual outcomes, some authors have confirmed that a decrease in contrast sensitivity can be a relevant side effect in post-LASIK eyes implanted with multifocal IOLs. For this reason, adequate patient selection considering different optic ocular aspects is crucial in postcorneal refractive surgery eyes to avoid unsatisfactory outcomes.

As previously mentioned, the implantation of EDoF IOLs has been also suggested to be a good option in eyes with...
previous corneal laser refractive surgery according to optical simulations. This has been also confirmed in some clinical studies evaluating the visual performance of bilateral cataract surgery with implantation of different models of EDOF IOLs. However, there is a lack of scientific evidence about the visual performance of unilateral implantation of EDOF IOLs in post-LASIK eyes developing cataract surgery in only 1 eye. A case of unilateral traumatic cataract in an adult young patient undergoing surgery with implantation of a new nondiffractive EDOF IOL is described in this study in which a successful binocular visual restoration was achieved with no remarkable visual disturbances and high levels of patient satisfaction. The specific model of extended range-of-vision IOL used in this case was selected because, in contrary to most popular EDOF in the market, it is not based on diffractive technology and has shown a visual disturbance profile similar to that corresponding to monofocal aspheric IOLs, providing extended range of vision from distance to near vision. By contrast, it is well-known that patients implanted with diffractive EDOF IOLs might experience a reduction in contrast sensitivity or halos and glare in low illumination conditions.

In the case reported in this study, a successful visual restoration was achieved in the eye implanted with the nondiffractive continuous extended range-of-vision IOL, obtaining values at 3 months postoperatively for UDVA, UIVA, and UNVA of 0.10, 0.10, and 0.20 logMAR, respectively. These values are consistent with those reported in virgin eyes using the same validated questionnaire. The remarkable visual improvement achieved had a significant impact on visual function-related quality of life, with improvements in the general vision, near activities, distance activities, social functioning, mental health, role difficulties, dependency, driving, and peripheral vision subscales of the VFQ-25 questionnaire. These good results in quality of life are consistent with those obtained after bilateral implantation of EDOF and multifocal IOLs in virgin eyes using the same validated questionnaire. It should be remarked that the improvement in the results of the VFQ-25 questionnaire may be due to the change in refraction and the replacement of the opacified crystalline lens by an element with transparent optics and not necessarily to the specific design of the IOL implanted. The VFQ-25 questionnaire should be applied in patients with binocular cataract surgery since the patient has 2 eyes for reading and driving. High levels of the VFQ questionnaire are expected in a patient with a monofocal IOL placement in the bag after cataract surgery for distance vision and driving activities.

Concerning visual quality, the same value of contrast sensitivity threshold was measured in the nonoperated eye compared with the eye implanted with Vivity IOL under photopic and mesopic conditions. The light distortion measured with the Light Disturbance Analyzer device was slightly higher in the eye implanted with the nondiffractive continuous extended range-of-vision IOL (distortion index 10.19% vs 3.82%) but achieving a value compatible with that can be measured after cataract surgery with implantation of a monofocal IOL (15.28% ± 6.87%). In addition, the optical effect of the ablation profile and the presence of amblyopia and a posterior vitreous detachment present in the right eye may have also affected the results of this test. This level of light distortion compatible with a monofocal IOL was consistent with the mild perception of glare reported by the patient, with no apparent perception of halos or starbursts. These good levels of visual quality in the right eye may have been facilitated by the aberrometric compensation between the negative spherical aberration induced by the anterior surface of the IOL and the positive spherical aberration associated with the post-LASIK oblate corneal profile. This compensation can result in a level of spherical aberration within the range that has been shown to optimize the depth of focus in the eye while maintaining excellent levels of visual quality.

In conclusion, this case report shows that the unilateral implantation of a nondiffractive continuous extended range-of-vision IOL can be a good solution in eyes with previous myopic corneal laser refractive surgery when monocular cataract surgery is needed, allowing a tolerable and successful binocular visual restoration. In any case, future studies should evaluate the impact of this type of unilateral interventions in stereoaucuity as this variable was not monitored in this case report. Furthermore, this IOL seems to be able to provide a successful visual restoration across all distances combined with high levels of visual quality and vision-related quality of life, especially when an efficient interaction is generated between the aberrometric profile of the IOL and corneal profile. However, larger prospective clinical trials with larger sample sizes are needed to confirm these findings.

WHAT WAS KNOWN

- Monocular implantation of a multifocal IOL provides satisfactory outcomes in young patients with 1 eye requiring cataract surgery, with a tolerable binocular summation for different viewing distances.
- Extended depth-of-focus IOLs can be a safe and efficacious option to restore the visual function in eyes with previous LASIK surgery, although considering the level of corneal higher-order aberrations and the IOL design and trying to match them.

WHAT THIS PAPER ADDS

- The unilateral implantation of a nondiffractive continuous extended range-of-vision IOL can be a good solution in young patients with previous myopic corneal laser refractive surgery and requiring cataract surgery in 1 eye, allowing a tolerable and successful binocular visual restoration.

REFERENCES


Disclosures: None reported.

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