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Case Report

Photorefractive Keratectomy for Correction of Residual Astigmatism After Cataract Surgery with a Presbyopia-correcting Intraocular Lens that Combines Extended Depth-of-focus and Multifocal Profiles

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Abstract

Introduction: This report describes a case involving photorefractive keratectomy (PRK) for correction of residual astigmatism after bilateral cataract surgery with implantation of a new range of presbyopia-correcting intraocular lenses (TECNIS Synergy).

Patient and Clinical Findings: A 68-year-old man who underwent cataract surgery with implantation of TECNIS Synergy IOL in both eyes presented 3 months after surgery with an uncorrected distance visual acuity (UDVA) of 20/50 in the right eye and 20/40 in the left eye. In addition, a corrected distance visual acuity (CDVA) of 20/20 in the right eye (+0.50 -1.25 × 180) and 20/20 in the left eye (+0.50 -1.00 × 180).

Diagnosis, Intervention, and Outcomes: The patient was diagnosed with residual astigmatism after cataract surgery in both eyes. Thus, PRK was planned for correction of the residual astigmatism in both eyes. The patient showed good postoperative outcomes with an uncorrected visual acuity of 20/20 at distance, 20/30+ at intermediate, and 20/20 at near in both eyes. He reported high satisfaction with the outcome.

Conclusions: PRK was safe and effective for correction of residual astigmatism after cataract surgery with TECNIS Synergy. Correction of small astigmatic and spherical errors with PRK is a reasonable approach for pseudophakic refractive errors.

Keywords: Photorefractive Keratectomy (PRK); Cataract Surgery; Corrected Distance Visual Acuity (CDVA)

Introduction

Modern cataract surgery with intraocular lens (IOL) implantation is increasingly becoming a refractive procedure with higher patient expectations of spectacle independence. Thus, residual refractive errors after cataract surgery with multifocal IOL implantation are not well tolerated by patients, leading to high dissatisfaction rates [1]. The postoperative refractive error should be minimized to achieve optimal visual outcomes, even with minor levels of astigmatism, since small amounts of astigmatism (>0.5 diopters [D]), hyperopia (>0.25 D), or myopia (>0.5 D) can occur and cause poor uncorrected distance visual acuity (UDVA) [2]. For the correction of pseudophakic refractive errors, laser vision correction (LVC) with laser in situ keratomileusis (LASIK) or photorefractive keratectomy (PRK) has been shown to be more precise and predictable for correction of small spherical and cylindrical errors, whereas piggyback IOLs and IOL exchange were more effective in correcting large spherical errors [3,4].

An extended depth of focus (EDOF) IOL provides a significantly greater range of vision with minimal optical side effects of multi-

focality [5]. However, postoperative refractive errors can possibly exacerbate problems inherent to such IOL designs, causing loss of contrast sensitivity or photic phenomena and resulting in higher postoperative dissatisfaction [6].

We report a case in which PRK was performed for correction of residual astigmatism in both eyes after cataract surgery with a new presbyopia-correcting intraocular lens that combines extended depth-of-focus and multifocal profiles (TECNIS Synergy IOL, Johnson and Johnson Vision) [5].

Patient Consent Statement was obtained from the patient.

Case Report

A 68-year-old man diagnosed with bilateral cataracts at another center presented to our clinic for cataract evaluation. Our examination showed an UDVA of 20/70 in the right eye and 20/80 in the left eye and a corrected distance visual acuity (CDVA) of 20/25 in the right eye (+1.0 - 1.25 × 180) and 20/30 in the left eye (+1.25 -1.25 × 180). The intraocular pressures and external ophthalmic examination results were normal. Anterior segment examination revealed 1+ cortical and 2+ nuclear sclerotic cataracts in both eyes, while posterior segment examination results were unremarkable. Corneal topography demonstrated with-the-rule regular astigmatism in both eyes (-1.18 D in the right eye and -0.94 D in the left eye).

The patient's refractive goals were discussed on the basis of the examination findings and topography, and cataract surgery with implantation of a presbyopia-correcting IOL (TECNIS Synergy IOL, Johnson and Johnson Vision) in both eyes was recommended. At the time of surgery, the Toric Synergy IOL was not available at our institution, and the patient was informed of the possibility of postoperative residual corneal astigmatism that may require excimer laser correction for improving UDVA.

The patient underwent uneventful cataract surgery with implantation of a +22.50 D and 22.0 D TECNIS Synergy IOL (Johnson and Johnson Vision) in the right and left eyes, respectively, based on preoperative optical biometry measurements and the Barrett Universal II formula. The main phacoemulsification incisions were placed on the steep axis with a 2.2-mm steel keratome blade on the basis of the preoperative corneal topography. Three months after cataract surgery, uncorrected distance visual acuity (UDVA) was 20/50 in the right eye and 20/40 in the left eye, with a corrected distance visual acuity (CDVA) of 20/20 in the right eye (+0.50 - 1.25 × 180) and 20/20 in the left eye (+0.50 - 1.00 × 180). The uncorrected intermediate visual acuity at 70 cm (UIVA) and the uncorrected near visual acuity at 40 cm (UNVA) were 20/60 and 20/20, respectively, in the right eye, and 20/50 and 20/20, respectively, in the left eye. The UIVA improved to 20/25 with distance correction in both eyes. The patient's expectations were to have better UDVA and UIVA. Thus, PRK was planned for correction of the residual astigmatism in both eyes. The patient received a thorough explanation of the efficacy and possible complications of PRK, and informed consent was obtained from him.

Surgical technique

PRK was performed in both eyes 3 months after the cataract surgery. The preoperative manifest refraction was selected as the target for correction. After topical anesthesia, the corneal epithelium was removed by mechanical scraping with a blade, and the cornea was cleaned thoroughly with a cellulose sponge. Aspheric non-wavefront-guided treatment was performed in both eyes using the NIDEK EC-5000 NAVEX excimer laser (Gamagori, Japan) with the following parameters: constant energy density, 130 mJ/cm^2; repetition rate, 40 Hz; optical zone, 5.0 mm; transition zone, 8.5 mm. The surgery was performed by a single surgeon (AP) and was uneventful. A therapeutic soft contact lens was placed after the surgery and removed 7 days later. Postoperatively, the patient was instructed to apply sodic diclofenac 0.1% (Volten, Oftalmi Laboratories, Caracas, Venezuela) eye drops four times a day for 1 week, tobramycin/dexamethasone (Tobradex, Alcon Laboratories Inc, Fort Worth, TX) four times a day for 1 week, fluorometholone 0.1% (Flumex, Allergan Laboratories, USA) three times per day for 4 weeks after removal of the soft contact lens, and preservative-free lubricants as needed for 2 months and beyond if required.

Results

At 3 months post-PRK, UDVA, UIVA, and UNVA were 20/20, 20/30+, and 20/20, respectively, in the right eye, and 20/20, 20/30+, and 20/20, respectively, in the left eye. CDVA was 20/20 (-0.25 × 100) in the right eye and 20/20 (-0.25 × 10) in the left eye. Corneal topography showed reduced corneal astigmatism in both eyes (Figure 1). The patients did not show corneal haze or other postoperative complications. The patient's satisfaction rate was high, with no complaints of halos or glare. Contrast sensitivity before and after PRK was unchanged (Table 1).

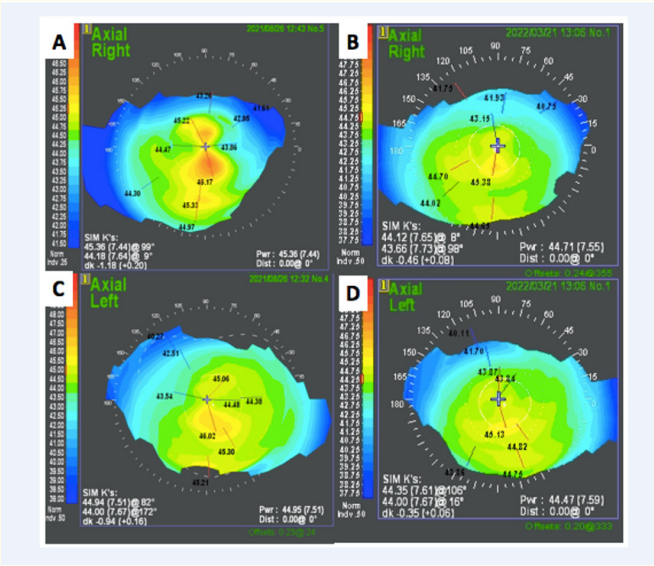

Figure 1: Corneal topography. A: Pre-PRK right eye. B: Right eye 3 months after PRK. C: Pre-PRK left eye. D: Left eye 3 months after PRK.

Spatial Frequency	PRE PRK	POST PRK
3	1.5	1.5
6	1.5	1.5
12	1.0	1.0
18	0.5	0.5

Table 1: Binocular contrast sensitivity before and 3 months after PRK under mesopic conditions without glare.

[a] Values are presented in log units.

Discussion and Conclusion

The TECNIS Synergy combines the optical benefits of multifocal and EDOF IOL profiles to deliver a range from distance to intermediate to near vision [5]. Other features of this IOL include its proprietary diffractive design, reduced spherical aberration to near-zero and correction of chromatic aberration, and violet light-filtering technology. Patients receiving multifocal IOLs tend to have very high expectations, with a recent study highlighting residual ametropia > 0.50 D as the mean cause for dissatisfaction [2]. In most cases, residual astigmatism can necessitate LVC. Seiler., *et al.* [7] showed that multifocal IOLs in cataract patients required LVC in 26% of the cases.

Ammetropia measurements are one of the difficulties associated with the use of multifocal lenses, and measurements in patients fitted with diffractive intraocular IOLs may not be reliable [3], since many aberrometers cannot achieve accurate measurement through these lenses because of changes in refraction with the lighting conditions and pupil size in the multifocal IOLs. Muftuoglu., *et al.* [8] showed no significant differences in refraction, UDVA, and UNVA between wavefront-guided and conventional LASIK for residual refractive errors after diffractive multifocal intraocular lens implantation. Aspheric non-wavefront-guided treatment was performed in both eyes of our patient.

Although both LASIK and PRK have been shown to be safe, effective, and predictable in patients with residual refractive error after cataract surgery, neither was superior to the other [4]. Both PRK and LASIK demonstrate excellent safety profiles, although LASIK may cause diffuse lamellar keratitis, flap displacement, and stromal wrinkles, all of which can independently promote development of significant amounts of visual aberration [4]. Correction of myopic or astigmatic residual refractive error with PRK thus represents a viable alternative to LASIK for avoiding many of these flap-related complications. PRK has been shown to be a safe and effective procedure to correct residual astigmatism following cataract surgery with the TECNIS Synergy IOL with no corneal haze or other postoperative complications. Our patient showed a residual astigmatism of -0.25 D in both eyes and a very high patient satisfaction rate, with no complains about halos or glare. The patient achieved excellent UDVA, UIVA, and UNVA in both eyes, similar to the results reported in one study after implantation of TECNIS Synergy [5].

While diffractive multifocal IOLs can reduce contrast sensitivity [9], LVC procedures can also cause a loss of contrast sensitivity [10]. The combination of a diffractive multifocal IOL and LVC may potentiate the loss of contrast sensitivity to a level of visual compromise for patients beyond residual refractive error [11]. However, Muftuoglu., *et al.* [8] evaluated the outcomes of LVC after multifocal IOL implantation and found that none of the patients lost more than one line of corrected distance vision. Our patient did not lose lines of CDVA, while the contrast sensitivity remained unchanged after PRK.

In conclusion, PRK was safe and effective for the correction of residual astigmatism after cataract surgery with TECNIS Synergy IOL. A reasonable approach for managing pseudophakic refractive

errors is to use PRK for correcting small astigmatic and spherical errors.

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Conflicts of Interest

None to disclose.

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