

Case Report

Undesirable High Astigmatism after Penetrating Keratoplasty in Pseudophakia Corrected with an Add-On Toric Intraocular Lens

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Keywords

Add-on intraocular lens · Astigmatism · Toric lens · Intraocular lens · Keratoplasty · Pseudophakic patients

Abstract

The purpose of the present case is to report the visual outcomes of a pseudophakic patient with high post-penetrating keratoplasty astigmatism treated with implantation of toric AddOn® intraocular lens (IOL) in the sulcus. A 79-year-old man with a ophthalmologic history of pseudoexfoliative glaucoma and Fuchs endothelial dystrophy had a graft failure after Desce-met's stripping automated endothelial keratoplasty procedure on his right eye. Consequently, a penetrating keratoplasty was performed, and a high corneal astigmatism of -9.8 D to 140° resulted in that eye after selective suture removal. A secondary AddOn® toric IOL customized for the patient with a manufacturer-calculated power of $+11.0$ D was implanted to 50° in sulcus of the right eye. Subjective refraction was used for IOL calculation. Final refraction was $+1.0$ D of sphere and -2.0 D of cylinder power to 105° , with spherical equivalent of 0.0 D. Best corrected visual acuity was logMAR 0.1 (20/25, 0.8 decimal) 1 year after the IOL implant. Our case report demonstrates that the toric AddOn® secondary IOL can be effective and safe in correcting residual refractive error of high regular astigmatism after keratoplasty in pseudophakic eyes.

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Introduction

Astigmatism is one of the major concerns following penetrant keratoplasty (PK), even with all advancement in corneal and refractive surgery [1]. Although corneal graft clearance

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and survival are the main objectives, good visual and refractive outcomes are crucial to the success of the procedure. Different therapeutic options are available for correcting post-PK residual astigmatism, however with considerable limitations. When astigmatism is high enough, non-surgical treatments such as spectacles or contact lenses (CLs) are not valid, so more invasive techniques are required. Relaxing incisions [2–4], compression sutures, wedge resection [5], and photorefractive procedures such as laser in situ keratomileusis [6] or photorefractive keratectomy [7] have been used as therapeutic approaches for high residual astigmatism correction. Toric intraocular lens (IOL) implantation is another reasonable option [8]. In pseudophakic cases, it may be challenging, as an add-on IOL especially designed for sulcus implantation is necessary [9, 10]. Furthermore, if astigmatism is high enough, the cylinder power has to be specifically calculated for each patient, and the toric add-on IOL is manufactured concretely for each case.

We report our experience in correcting post-keratoplasty very high astigmatism in a pseudophakic patient with unknown power IOL and pseudoexfoliation syndrome, with implantation of a personally manufactured AddOn[®] toric IOL (1stQ GmbH, Mannheim, Germany) in the sulcus. The CARE Checklist has been completed by the authors for this case report, attached as online supplementary material (for all online suppl. material, see <https://doi.org/10.1159/000530281>).

Case Report

A 75-year-old man with an ophthalmologic history of pseudoexfoliative glaucoma with trabeculectomy in both eyes and Fuchs endothelial dystrophy underwent phacoemulsification surgery on his right eye in another ophthalmological center. Implantation of an unknown power IOL in the capsular bag was performed. He was referred to our hospital a few months later for endothelial decompensation and corneal edema. A Descemet's stripping automated endothelial keratoplasty procedure was indicated, and surgery was performed without incidence. Several months after, endothelial graft failure occurred, and PK was indicated because of significant stromal opacity and patient's preference due to his difficulty performing postoperative posture. An 8.5 mm of the host cornea was trepanned, and a 9.0 mm of donor corneal was then sutured with an interrupted 10/0 nylon suture. One year following PK, suture removal was completed and a clear corneal graft was obtained (shown in Fig. 1), but the patient was concerned about unsatisfactory visual result. Uncorrected visual acuity was logMAR 1.3 (20/400, 0.05 decimal), and best-corrected visual acuity was logMAR 0.2 (20/32, 0.63 decimal). Subjective refraction was +6.0 D of sphere and –9.0 D of cylinder with axis to 140°. Different treatment options were discussed with the patient. According to the resources available in our hospital, implantation of a secondary sulcus toric lens (sometimes referred to as add-on lens) or another PK were our available treatment alternatives. Implantation of a secondary IOL (AddOn[®] [1stQ GmbH, Mannheim, Germany]) was agreed to be the chosen treatment.

Pseudophakic biometry and corneal power measurements were obtained with IOL Master 500 (Carl Zeiss Meditec, Jena, Germany): axial length (AL) of 24.52 mm, anterior chamber depth of 4.00 mm, anterior keratometry of K1 38.3 D (8.67 mm) to 142.1° and K2 48.1 D (6.92 mm) to 52.1°, with –9.8 D to 140° of cylindrical power. The final IOL power was calculated based on stable subjective refraction and biometry data obtained with IOL Master 500 (Carl Zeiss Meditec, Jena, Germany). Pentacam (Oculus Inc., Wetzlar, Germany) was used for regular astigmatism diagnosis, to discard ectasia, and to verify the amount of total astigmatism power (Fig. 2).

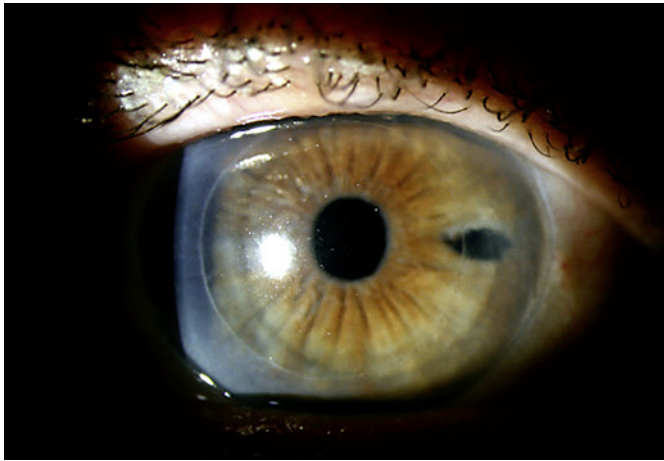


Fig. 1. Clear corneal graft 1 year after penetrating keratoplasty and suture removal.

The selected AddOn[®] (1stQ GmbH, Mannheim, Germany) toric secondary lens was an A4FW00 with +2.25 D of spherical equivalent and +11.0 D of cylindrical power to be implanted to 50°, calculated by the company using an online available AddOn[®] toric calculator (<https://www.1stq.de/en/addon-calculator>), and specially manufactured for the patient. This is a hydrophilic acrylate lens with 13.00 mm of overall diameter and 6.00 mm of optic diameter. It is a one-piece square-shaped lens with convex-concave optics and four soft flexible haptics (Fig. 3). These attributes improve rotational stability in the sulcus, avoid iris capture, reduce edge light scatter, and help maintain a constant distance between it and the posterior primary lens [11].

Fourteen months after PK, the toric add-on IOL designed by the manufacturer was implanted under topical anesthesia in the sulcus of the right eye. The correct axial position was marked with a surgical pen and a lens manual marking system with the patient seated upright before surgery. The toric add-on IOL was implanted with an injector previously loaded by the surgeon without incidences. No corneal sutures were applied.

The follow-up was taken over 1 year. Mean IOP during this period was 15.42 ± 3.5 mm Hg (11–18 mm Hg) with no IOP drops used.

The postoperatively subjective refraction was a sphere power of +1.0 D and a cylinder power of -2.0 D to 105°, which spherical equivalent was 0.0 D. The best-corrected visual acuity improved to logMAR 0.1 (20/25, 0.8 decimal). Analysis of toric IOL implantation results was carried out with “Berdahl and Hardten toric IOL calculator results” (www.astigmatismfix.com/calculate.php). Results showed that rotating the toric IOL 5° clockwise to 45° should reduce astigmatism to below 0.75 D. As visual results were satisfactory and in accordance with the patient, no IOL rotation procedure was performed.

Clear corneal graft without endothelial decompensation was observed in posterior slit-lamp examination. Final endothelial cell counting was 2,551 cells/mm², and IOP remained at 15 mm Hg.

Discussion

High residual astigmatism is a limiting factor for visual rehabilitation of post-keratoplasty patients. Several treatments are used for astigmatism in those post-PK pseudophakic cases, but sometimes it cannot be easily corrected. Spectacles or CLs can only be used in mild to

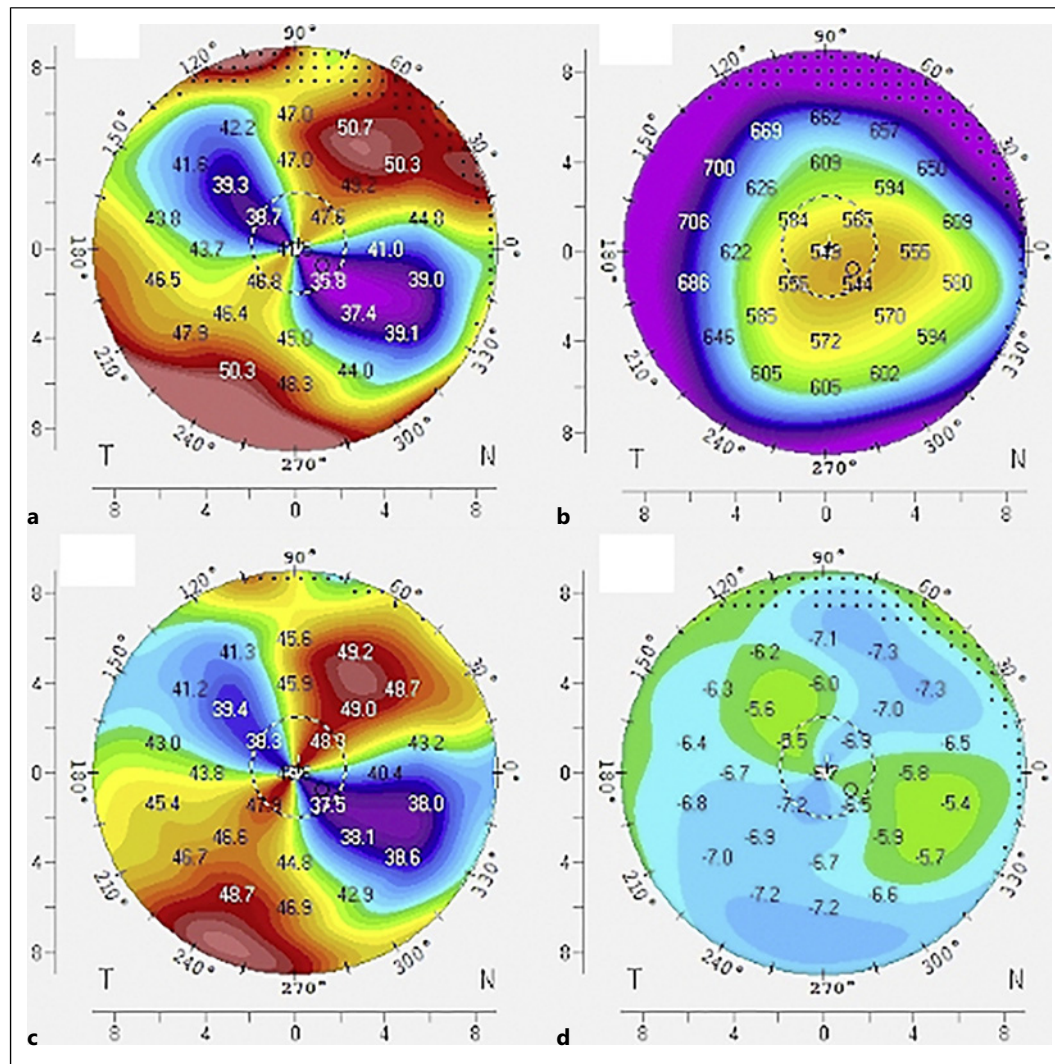


Fig. 2. Corneal topography obtained with Pentacam (Oculus Inc., Wetzlar, Germany). **a** Total corneal refractive power map. **b** corneal thickness (or pachymetry map). **c** Anterior axial curvature map. **d** Posterior axial curvature map.

moderate astigmatism, have a greater risk of graft infection, and might be difficult to fit after PK [12]. Moreover, they are not an option for patients with anisometropic aniseikonia or CL intolerance. Corneal or limbal relaxing incisions may not be powerful and predictable enough for correct high levels of astigmatism in many cases [2–4]. Surgical treatments such as photorefractive keratectomy or laser in situ keratomileusis have been proposed as available options for post-PK high astigmatism [6, 7]. However, more corneal graft manipulation has to be done and sufficient residual corneal thickness must be guaranteed, which in some cases limits the amount of astigmatism correction. Additionally, some undesirable effects such as haze and corneal scar formation, graft rejection, or dehiscence may appear so these procedures should be taken with caution [13]. Avoiding keratorefractive procedures, the only available option for pseudophakic patients is the implantation of an individually manufactured secondary toric IOL in the sulcus.

This surgery entails minor graft manipulation and possibility of IOL removal, which means reversibility of the procedure [9]. Rotational stability is a very important factor to

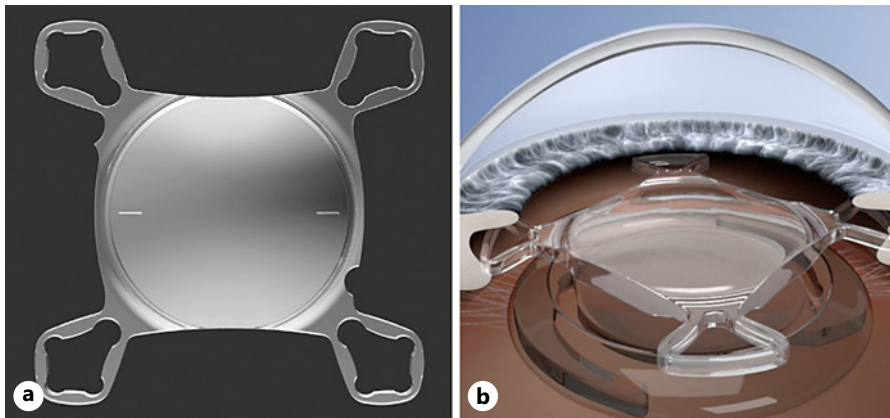


Fig. 3. Images of the AddOn® toric secondary IOL. **a** Design with four soft flexible haptics, square shape, and convex-concave optic. Toric marks are visible. **b** Virtual image of the IOL implanted into the sulcus in addition to the capsular-bag fixated basis IOL.

obtain successful visual outcomes, and an IOL specially designed for it is needed. A new, technically more sophisticated generation of additive IOLs promises optimal centering of the IOL in the ciliary sulcus and thus increased rotational stability.

The AddOn® (1stQ GmbH, Mannheim, Germany) implanted in our patient has four soft haptics that provide optimal centering in the sulcus, regardless of its size and shape, which ensures rotational stability. Surgery for its implantation does not imply greater risks as it is done with a simple limbo-corneal incision in an atraumatic procedure with topical anesthesia. Calculation of the IOL power is one of the most challenging steps in this procedure, and biometry, topography, and subjective refraction have to be compared and analyzed rigorously. Manufacturer provides add-on toric IOL calculation and gives the selected power and IOL. There is not much reports about use of this toric sulcus IOL in literature. Gundersen and Potvin [14] reported refractive and visual outcomes of 18 patients after implantation of the AddOn® toric IOL in the sulcus to correct residual astigmatism (ranged from -2.50 D to 1.75 D) in pseudophakic patients. Mean residual refractive astigmatism was significantly reduced, and the mean absolute lens orientation was $4.9 \pm 3.7^\circ$ from intended. No statistically significant differences between IOP before and after were found. Hassenstein et al. [10] implanted this secondary toric IOL in the sulcus of 15 pseudophakic patients with residual astigmatism after PK. The mean cylinder of subjective refraction was 6.5 ± 2.85 D preoperatively. Postoperatively, uncorrected visual acuity improved from $<0.05 \pm 0.09$ to 0.4 ± 0.23 , and the final median spherical equivalent was -0.88 ± 1.74 D. A revision for rotation of the toric add-on IOL was necessary in 1 case. No other complications during 10-month mean follow-up were found.

Summarizing, there is one report [14] describing clinical results of this toric secondary IOL in pseudophakic patients and only one [10] with pseudophakic patients with PK and high residual astigmatism, both reporting good and predictable visual outcomes. As demonstrated in our patient, high regular corneal astigmatism of -9.8 D can be effectively corrected with this add-on IOL in a patient who had underwent cataract surgery and posteriorly a penetrating keratoplasty. No clinically significant difference in IOP before and after the IOL implantation seems to have developed at 1-year follow-up. Other complications such as interlenticular opacities, lens decentring, pigment dispersion, or iris capture have not yet been observed. Based on our experience, pseudoexfoliative glaucoma may not be a contraindication for an add-on IOL implantation, although indication should be cautious. Our report provides documented clinical and visual outcomes of the use of secondary toric IOL AddOn® (1stQ

GmbH, Mannheim, Germany) for correction of high astigmatism post-PK in a pseudophakic patient with pseudoexfoliative glaucoma. The implantation of the AddOn[®] toric IOL in the sulcus is a safe and effective procedure for visual rehabilitation in pseudophakic patients with high residual corneal astigmatism after penetrating keratoplasty.

Statement of Ethics

The case report adhered to the tenets of the Declaration of Helsinki. The written informed consent was obtained from the patient for publication of this case report and any accompanying images. Ethical approval is not required for this study in accordance with local or national guidelines.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Pau Cid-Bertomeu: conception, design, drafting, analysis, and interpretation of the work. Magí Vilaltella: acquisition and analysis of data for the work. Valentín Huerva: revising it critically and final approval of the version to be published.

Data Availability Statement

All data generated or analyzed during this study are included in this article and its supplementary material files. Further inquiries can be directed to the corresponding author.

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