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Use of a Toric Intraocular Lens and a Limbal-Relaxing Incision for the Management of Astigmatism in Combined Glaucoma and Cataract Surgery

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Key Words
Toric intraocular lens · Limbal-relaxing incision · Astigmatism

Abstract
Purpose: We report the surgical management of a patient with glaucoma undergoing cataract surgery with high preexisting astigmatism. A combination of techniques was employed for her astigmatism management. ***Methods:*** A 76-year-old female with 5.5 dpt of corneal astigmatism underwent surgery in her left eye consisting of one-site trabeculectomy, phacoemulsification, toric intraocular lens implantation and a single inferior limbal-relaxing incision. ***Results:*** Intraocular pressure control was achieved with no medication at 11 mm Hg; before the filtering procedure, the pressure was 16 mm Hg on two topical drugs. Astigmatism was reduced to 0.75 dpt, and both corrected and uncorrected visual acuity improved. ***Conclusions:*** Astigmatism management can have a good outcome in combined procedures. We encourage surgeons to address astigmatism in the preoperative planning of patients undergoing glaucoma surgery associated with phacoemulsification.

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Introduction

Astigmatism management in cataract surgery is a well-studied issue, and many techniques are available for its correction, namely limbal-relaxing incisions (LRIs), arcuate keratotomies, toric intraocular lenses (IOL), paired incisions on the steep axis or subsequent excimer laser ablation (bioptic) [1]. It has been reported that 20% of all cataract patients have clinically significant astigmatism, usually >1.5 dpt [2]. Even though this has not been specifically studied in the surgical glaucoma population, one could argue that as they correspond to the same age group, the prevalence of significant astigmatism should closely resemble the previously reported statistic.

Specifically, when astigmatism correction calls for a lens with a toric power >4 dtp, IOL powers are not readily available in some areas for its total correction; this can account for about 7% of all cataract surgery candidates [2]. Depending on the steep axis, the patient's age, the amount of astigmatism to be corrected and the induced astigmatism of our procedure, there may be a need for combining astigmatism management options. Furthermore, induced astigmatism after glaucoma filtering surgeries has been subject to numerous studies and has been reported to be vary between 0.3–2.25 dpt [3–5], though results are highly variable. For this reason, each surgeon is encouraged to calculate their own induced astigmatism for glaucoma filtering procedures and combined procedures.

Even though combined phacoemulsification and glaucoma surgery are not as common as each one of these procedures by themselves, astigmatism management should not be overlooked in the preoperative planning. A glaucoma patient with good visual acuity potential can benefit from astigmatism correction. Keeping in mind the excellent refractive outcomes of cataract surgery, patients have come to expect good surgery results.

Case Presentation

A 76-year-old female with bilateral chronic open-angle glaucoma was evaluated in the clinic. At her initial encounter, she was on treatment with latanoprost QD and timolol 0.5% b.i.d. in both eyes. Her IOP readings were OD 15 and OS 18 mm Hg. She had advanced glaucomatous damage with a vertical cup-disc ratio of 0.8 in both eyes; with a superior notch in OD and an inferior notch in OS. Her visual fields were consistent with the optic nerve appearance with an inferior scotoma in Bjerrum's area in OD and a superior one in OS. Glaucoma progression was established in her left eye despite medical therapy through the deepening and extension of previous scotoma confirmed over 3 consecutive visual fields 3–4 months apart.

Her preoperative uncorrected visual acuity was 20/400 OU. Best spectacle-corrected visual acuity was 20/70 with –10.75 + 6.75 × 98° in her right eye and 20/100 with –7.25 + 6.0 × 75° in her left eye. Manual keratometry readings were OD 39.75 × 45.75 × 98° (6.0 at 8°) and OS 40 × 45.5 × 81° (5.5 at 171°). A picture of the Pentacam tomography (Oculus, Wetzlar, Germany) of her left eye is presented (fig. 1).

Her slit-lamp evaluation revealed a 2+ grade nuclear cataract. Gonioscopy showed open angles with no synechiae. Dilation was good, and a preoperative endothelial cell count revealed OD 2,443 and OS 2,216.

With all this in mind, it was decided that a combined glaucoma and cataract extraction surgery in her left eye was in the patient's best interest. As discussed with the patient who had high expectations from the cataract portion of the intervention, her astigmatism was going to be addressed at the time of her surgery.

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Biometry (IOL MASTER; Carl Zeiss, Oberkochen, Germany) for OS suggested a SN60T5 lens with a spherical power of +21.0 dpt (Toric Acrysof; ALCON USA, Fort Worth, Tex., USA) for a target of –0.21 dpt, but with calculated 3.35 dpt of residual astigmatism at 78° (www.toricacrysofcalculator.com). The induced astigmatism introduced in the formula was 0.7 dpt at 118°, which was calculated by the surgeon (A.G.) from all his previous one-site combined procedures (after a minimum of 6 months of follow-up). As of the moment of surgery, the highest toric power in this platform available was SN60T5 (this was prior to the appearance of the IQ platform), which corrects 3.0 dpt in the IOL plane but only 2.0 dpt of astigmatism at the corneal plane.

Calculation with the Donnenfeld nomogram based on the 3.35 dpt of residual astigmatism at 78° was used for the residual astigmatism (www.lricalculator.com) using the original keratometry readings. We only calculated for an inferior incision (this option is enabled in the website) due to concerns about the superior incision interfering with the trabeculectomy, the traction suture or mattress suture. The anticipated residual total astigmatism was 2.0 at 78°.

The patient was marked in the upright position preoperatively at 3, 6 and 9 o'clock positions. We marked the future incision length from the inferior 40–120°. The LRI was made 80° long, centered at the inferior 80° according to the nomogram, using a diamond blade LRI knife preset at 550 μm (Rumex International Co., Clearwater, Fla., USA).

A standard superior one site phacotrabeculectomy with a fornix-based flap and mitomycin C 0.02% for 3 min was conducted. A traction suture was placed in the clear cornea with a silk 7–0 suture. The incision location was at 110°, the flap was 3 mm wide and 2.5 mm from anterior to posterior. The phacotrabeculectomy was done through a 2.75 incision with a tapered Kelman microtip with 100% OZil on an Infinity platform (Alcon, Fort Worth, Tex., USA). The IOL was inserted and rotated to 80°, and the viscoelastic was removed. The flap was sutured with 10–0 monofilament with 5 sutures. No filtration was present at the end of the surgery, as to avoid low IOP in the early postoperative period and possible IOL rotation. Intraocular miotics were used at this time after having a final check of the lens centration. The conjunctiva was sutured with the same monofilament, and a single mattress suture was placed.

The IOP remained stable in the early postoperative period (<20 mm Hg and >14 mm Hg). Laser suture lysis of all flap sutures starting on day 7 and during the following 3 weeks was done until a filtering bleb was present and persisted spontaneously from one follow-up visit to another. Conjunctival sutures were removed at 30 days after the surgery. No chamber shallowing was seen throughout the postoperative period.

Three months after the surgery, uncorrected visual acuity was 20/30–2 OS, and best spectacle-corrected visual acuity was 20/30 + 2 with –0.5 + 1.0 × 74°. Keratometry readings in OS were 41.0 × 44 × 82° (3.0 at 162°). Her IOP in the left eye is currently 11 mm Hg with no IOP-reducing medication. The lens appeared centered and rotationally stable, the LRI was still clearly visible at 3 months (fig. 2, fig. 3).

The patient has refused surgery on the other (better) eye due to the fact that she now functions quite well with her operated eye, and we have changed the treatment to a fixed combination of brimatoprost and timolol. We expect to conduct surgery when her cataract progresses.

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Discussion

A case of successful astigmatism management in the context of a combined cataract extraction with a glaucoma-filtering procedure, using a combination of a toric IOL and a single LRI is described.

The optimal management of astigmatism at the time of a combined procedure requires the knowledge of all available techniques. It is very important to assess preoperative corneal astigmatism and decide on the best-available option according to each surgeon's experience and availability. If one intervention for the reduction of astigmatism is not enough, then a second procedure can be added if residual astigmatism can be calculated with a reasonable amount of certainty. For this, it is critical to review the surgeon's log and to work with the average-induced astigmatism of previous cases, keeping in mind the variability proper to these calculations.

Toric IOLs offer a precise way of correcting the corneal cylinder. Although they are somewhat expensive, commercially available models can now correct up to 4.0 dpt of astigmatism in the corneal plane. Rotation is an issue, which should be studied in a bigger cohort with longer follow-up periods, although there is data supporting the use of toric IOLs in glaucoma patients [6]. We did not see any rotation in this case. In cases of cataract surgery, rotational stability has been well documented with this IOL platform [7], but pressure fluctuations in the early postoperative period could theoretically lead to some rotation and even to change in the astigmatism power and axis only because of hypotony. The prospect of ever higher astigmatism-correcting platforms that will allow a higher correction of astigmatism without the need to combine procedures is very promising.

LRIs constitute an inexpensive and reliable way of correcting corneal astigmatism but by themselves do not correct over 2.5 dpt of the cylinder, and their results can be somewhat variable, unless in experienced hands [8]. They are a good option to combine with toric IOLs. The combination used in this patient is a compromise between availability, technical ease and affordability. There is always the possibility of a posterior bioptic or a superior LRI, if the above combination proved to be insufficient. Some surgeons are comfortable performing LRIs at the office on a follow-up visit. Another inexpensive alternative to this are paired corneal incisions; though the effect tends to be variable and unpredictable, they can correct up to 2 dpt of the corneal cylinder [9]. However, having well-constructed, sealed incisions is an issue in the active hands-on management of these patients.

The reason why this combination was so successful in this case was probably due to 2 factors. Either the induced astigmatism with the scleral flap incision was greater than that calculated (0.7 at 118°) and/or the relaxing incision corrected more astigmatism than expected. Maybe both mechanisms coexisted. We must keep in mind the variable nature of both these procedures when performing them; in any case, a great reduction of astigmatism will be achieved.

Finally, another alternative is corneal-based photoablation. I believe it not to be ideal due to the altered biomechanics of the postablation cornea, affecting posterior IOP measurements. Even more, during lasik procedures done with microkeratomes or femtosecond technology, in which a suction ring is used, pressures well >100 mm Hg have been documented [10, 11]. This is something we do not desire in a patient with sufficient glaucomatous damage to warrant a trabeculectomy.

In these usually fragile patients, longer operative times should be compensated with the benefits of a single procedure [12]. However, we must always keep in mind the more important intraoperative and postoperative goals in glaucoma patients. Glaucoma is an irreversible optic neuropathy. Astigmatism can almost always be corrected by spectacles, con-

tact lenses or be managed surgically afterwards. Having stated that, I believe astigmatism management is something that should be routinely considered in the preoperative evaluation of patients undergoing cataract surgery, be it alone or combined with a trabeculectomy. A larger case series would of course provide more information on the refractive results and stability in these patients.

Statement of Ethics

Informed consent was obtained for this procedure.

Disclosure Statement

There are no conflicts of interest to be declared.

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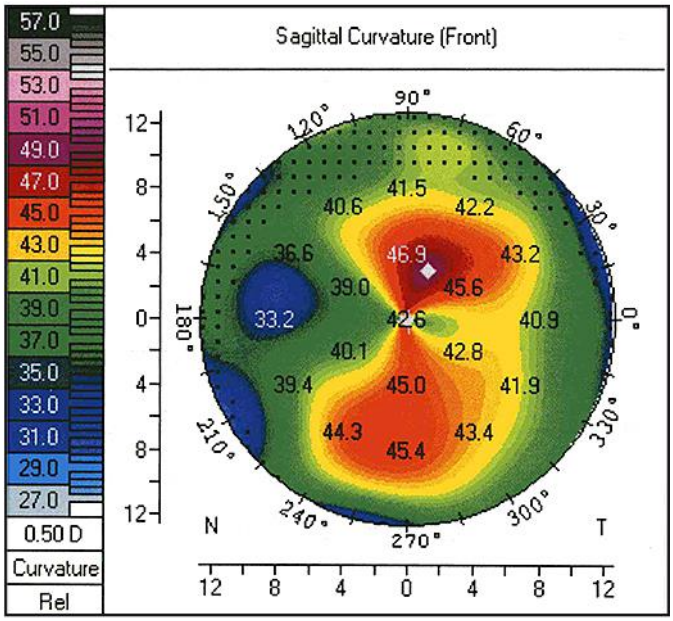

Fig. 1. Preoperative topography of the patient's left eye prior to having undergone a combined one-site cataract and trabeculectomy surgery with a LRI. Regular 5.5 dpt of the rule astigmatism can be seen with an axis of 80°.

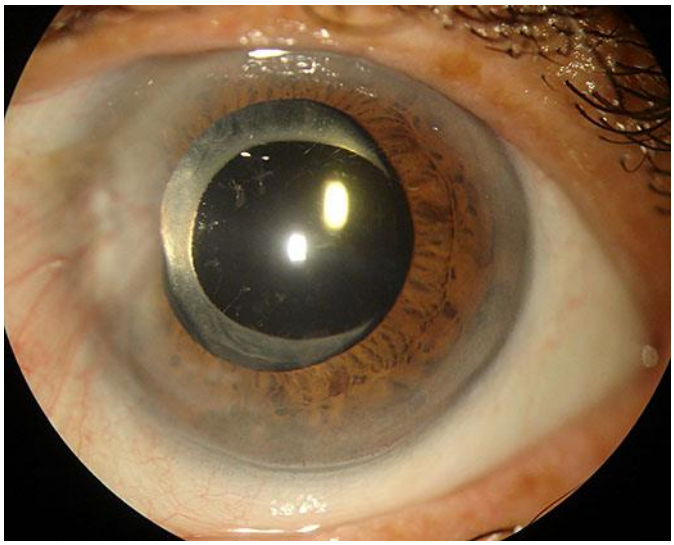

Fig. 2. Clinical photograph of the patient's left eye 3 months after combined one-site cataract and trabeculectomy surgery with a LRI.

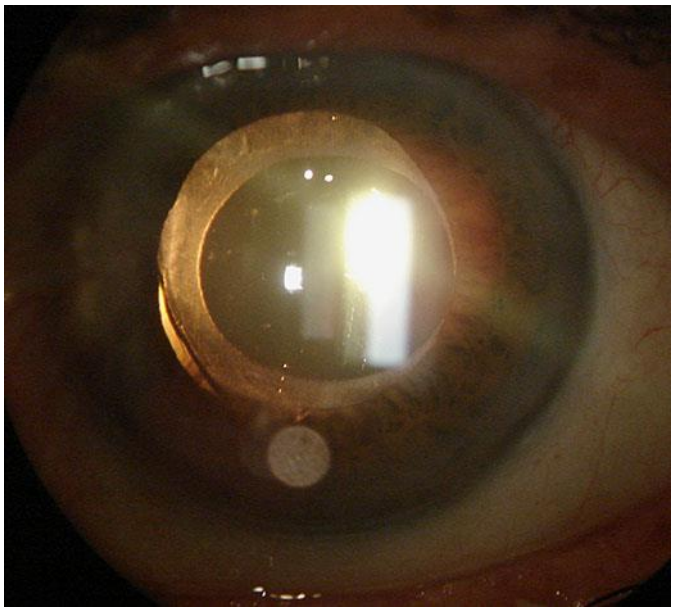

Fig. 3. Clinical photograph of the patient's left eye 3 months after combined one-site cataract and trabeculectomy surgery with a LRI. In retroillumination, we can verify the rotational stability of the lens at 80°.