High-cylinder Acrylic Toric Intraocular Lenses: A Case Series of Eyes With Cataracts and Large Amounts of Corneal Astigmatism

Guadalupe Cervantes-Coste, MD; Laura Garcia-Ramirez, MD; Erick Mendoza-Schuster, MD; Cecilio Velasco-Barona, MD

ABSTRACT

PURPOSE: To examine the stability and efficacy of high-cylinder power AcrySof toric intraocular lenses (IOLs), models SN60T6, SN60T7, SN60T8, and SN60T9 (Alcon Laboratories Inc).

METHODS: Eligible eyes had cataract and symmetric corneal astigmatism ≥2.25 diopters (D). Outcomes included monocular uncorrected distance visual acuity (UDVA), manifest refraction, and assessment of IOL axis.

RESULTS: Nineteen eyes from 14 patients had preoperative corneal astigmatism of 4.00±1.10 D. Postoperatively, residual refractive cylinder was 0.55±0.60 D at 3 months. Uncorrected distance visual acuity was 1.3±0.5 logMAR preoperatively and improved to 0.11±0.09 logMAR 3 months postoperatively (P<.0001). All IOLs were stable within 5°.

CONCLUSIONS: The IOLs were stable and effective in correcting high amounts of preexisting astigmatism at the time of cataract surgery. [J Refract Surg. 2012;28(4):302-304.]

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Operative Procedures

After receiving sedation and anesthetic drops, patients were seated at the slit-lamp, which was equipped with an angle-measuring reticle (BX 900 Photo Slit-Lamp; Haag-Streit AG, Koeniz, Switzerland). A thin slit was turned to the 0 and 180° marks. The corneal limbus was scratched at these locations with a sterile insulin needle and inked with a sterile marker. These reference marks were later used during surgery to mark the steep corneal meridian and site of incision, using a Mendez gauge (Duckworth and Kent Ltd, Baldock, United Kingdom).

The anterior chamber was entered with a 1.0-mm stab incision and a 2.2-mm clear corneal incision. Phacoemulsification was performed in a routine fashion. The IOL was injected into the capsular bag. During viscoelastic removal, the IOL was held with a second instrument (Seibel nucleus chopper; Rhein Medical Inc, St

From the Asociación Para Evitar la Ceguera en México, Hospital De Luis Sánchez Bulnes, Mexico City, Mexico.

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Correspondence: Guadalupe Cervantes-Coste, MD, Av México 85-5, Mexico City 06100, Mexico. E-mail: gpecervantes@hotmail.com

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Petersburg, Florida) that was inserted through the side-port incision, maintaining the IOL at an axis between 10° and 15° short of (counterclockwise) its intended axis. The anterior chamber was reformed and the incisions were sealed. The IOL was then aligned to its final axis with a cannula, using small movements. If an IOL rotated >15° past the intended axis, the surgeon injected an additional bolus of cohesive viscoelastic, turned the IOL less than half of a clockwise rotation (until the IOL was again 10° to 15° short of its intended axis), and performed alignment again.

### POSTOPERATIVE FOLLOW-UP

Analyses at 1 week, 4 weeks, and 3 months postoperative included Snellen UDVA and corrected distance visual acuity (CDVA), manifest refraction, and retroillumination photography. Retroillumination images were captured with an EOS 30 D camera (Canon Inc, Lake Success, New York). The IOL axis was assessed by superimposing the image on a grid, comparing the postoperative axis to the surgical axis, and categorizing the axis as stable within 5° or as rotated >5°. Snellen visual acuities were converted to logMAR for averaging.

### RESULTS

Nineteen eyes from 14 patients were evaluated with the toric IOL models and cylinder power as shown in the Table. Mean spherical power of the IOL was 22.10±3.90 D (range: 13.00 to 29.50 D).

### CORNEAL ASTIGMATISM AND REFRACTIVE CYLINDER

Preoperative corneal astigmatism was 4.00±1.10 D (range: 2.28 to 6.80 D), with a distribution as shown in Figure 1. Mean residual refractive cylinder at 3 months postoperative was 0.55±0.60 D \( (P<.0001) \), with a distribution as shown in Figure 1. Six eyes had >0.50 D of residual refractive cylinder at 3 months postoperative. Of those, three eyes were undercorrected, two eyes experienced axis shifts from the rule to oblique (changes of 35° and 38°), and one eye was overcorrected with an axis flip from one direction of oblique astigmatism to the perpendicular direction of oblique astigmatism.

### VISUAL ACUITY AND REFRACTION

Stability of refraction with time after surgery is shown in Figure B (available as supplemental material in the PDF version of this article). Mean preoperative UDVA was 1.3±0.5 logMAR (20/400 Snellen), with a distribu-

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**TABLE**

<table>
<thead>
<tr>
<th>Lens Cylinder Power (D)</th>
<th>Model Number</th>
<th>At Lens Plane</th>
<th>At Typical Corneal Plane</th>
<th>No. of Eyes (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN60T6</td>
<td>3.75</td>
<td>2.57</td>
<td>2 (10.5)</td>
<td></td>
</tr>
<tr>
<td>SN60T7</td>
<td>4.50</td>
<td>3.08</td>
<td>6 (31.6)</td>
<td></td>
</tr>
<tr>
<td>SN60T8</td>
<td>5.25</td>
<td>3.60</td>
<td>4 (21.1)</td>
<td></td>
</tr>
<tr>
<td>SN60T9</td>
<td>6.00</td>
<td>4.11</td>
<td>7 (36.8)</td>
<td></td>
</tr>
</tbody>
</table>

Lens cylinder powers are from the product information.

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**Figure 1.** Cylinder for eyes in the study; preoperative corneal astigmatism versus 3-month postoperative refractive cylinder. The diagonal line represents zero change; values beneath the diagonal line represent an improvement in cylinder. The available correction limit (4.60 D) is a combination of the intraocular lens (maximum 4.11 D at the corneal plane) and the surgically induced astigmatism (0.50 D).
tion as shown in Figure 2. At 3 months postoperative, mean monocular UDVA was 0.11±0.09 logMAR (~20/25 Snellen), an improvement that was clinically and statistically significant ($P<.0001$ by paired $t$ test). Mean postoperative monocular CDVA was 0.02±0.05 logMAR (~20/20 Snellen). All eyes had postoperative UDVA of 20/40 or better and a postoperative CDVA of 20/30 or better. The distribution of postoperative UDVA is shown in Figure 2.

**ROTATIONAL STABILITY**

All IOLs were stable within 5° during the postoperative period.

**DISCUSSION**

In this study of 19 eyes with cataracts and a large magnitude of preoperative corneal astigmatism, AcrySof toric IOLs with high-cylinder powers were effective in reducing the corneal cylinder and providing accurate UDVA. These results compare favorably with the limited available data, as shown in Table A (available as supplemental material in the PDF version of this article). All IOLs in this study remained correctly rotationally aligned through 3 months postoperative. The small sample size of this study (19 eyes) made it unlikely that IOL rotation significant enough to require repositioning would be observed; in larger studies of AcrySof toric IOLs with lower cylinder power, 0.6% to 1.1% of IOLs were repositioned. Accuracy of alignment in our study was potentially enhanced by using an insulin needle to make the reference marks (rather than marks that could smudge or blur); a similar strategy has been described elsewhere. Rotational stability may have been facilitated by the ophthalmic viscosurgical device (OVD). Residual OVD may allow the lens to rotate, and surgeons have debated the use of various OVD with toric IOLs. Experience with toric IOLs having lower cylinder power has shown that a cohesive OVD is easier to remove than a dispersive or second-generation OVD, as long as the toric IOL is rotationally stabilized with a second instrument during OVD removal.

Our pilot study indicates that AcrySof toric IOLs with high-cylinder powers are an effective option to compensate for large amounts of preexisting astigmatism at the time of cataract surgery. Further studies are needed with larger populations and longer follow-up.

**AUTHOR CONTRIBUTIONS**

Study concept and design (G.C.C.); data collection (L.G.R., E.M.S., C.V.B.); critical revision of the manuscript (G.C.C., L.G.R., E.M.S., C.V.B.)

**REFERENCES**

Figure A. Algorithm for selecting incision location to reduce residual astigmatism. Three iterations are shown, but more iterations could be used if necessary.

Figure B. Stability of refraction. Preoperatively, the vision of most patients was so poor that manifest refraction was not possible, therefore, preoperative corneal astigmatism is plotted with postoperative manifest refraction spherical equivalent. At all time points, n = 19 eyes.
<table>
<thead>
<tr>
<th>Correction Strategy</th>
<th>Toric IOL Haptic Type</th>
<th>No. of Eyes</th>
<th>Preoperative Corneal Cylinder (D)</th>
<th>Postoperative Refractive</th>
<th>Postoperative UDVA 20/40 or Better (n, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-cylinder toric IOL (current study)</td>
<td>Compressible</td>
<td>19</td>
<td>4.00±1.10</td>
<td>0.55±0.60</td>
<td>19 (100)</td>
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<td>High-cylinder toric IOL6</td>
<td>Plate</td>
<td>21</td>
<td>4.50±2.20</td>
<td>0.45±0.63</td>
<td>16 (76.1)</td>
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<td>Toric IOLs plus limbal relaxing incisions3</td>
<td>Compressible</td>
<td>10</td>
<td>3.10±0.80</td>
<td>0.80±0.70</td>
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<td>Piggyback toric IOLs7</td>
<td>Plate</td>
<td>1</td>
<td>5.12</td>
<td>1.00</td>
<td>1 (100)</td>
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<tr>
<td>Sutured piggyback toric IOLs8</td>
<td>Plate</td>
<td>2</td>
<td>4.25, 4.87</td>
<td>0.50</td>
<td>2 (100)</td>
</tr>
</tbody>
</table>

IOL = intraocular lens, UDVA = uncorrected distance visual acuity, N/A = not available