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Postoperative results were taken at 3 months. Refraction and visual outcomes were monitored. For further analysis, preoperative corneal astigmatism data were designated into 3 groups as follows: with the rule (WTR), against the rule (ATR), and oblique (OBL).

Statistical analysis was performed using SPSS V20 (SPSS, IBM, USA). Student t tests were used to determine the difference in mean postoperative values among groups. A P value of 0.05 was considered statistically significant.

**RESULTS**

Forty-four eyes of 44 patients (20 men, 24 women) were included in the toric multifocal IOL cohort and 76 eyes of 63 patients (29 men, 34 women) were included in the toric monofocal group.

**Refractive Data**

Preoperative and postoperative refractive data are included in Table 1. Monofocal IOL group patients (77.9%) achieved a postoperative spherical equivalent (SE) within plus or minus 0.5 D and 94.7% of patients had refractive cylinder within plus or minus 0.5 D. The multifocal group (93.3%) fell within 0.5 D of the intended SE postoperatively and 88.7% of patients had refractive cylinder within plus or minus 0.5 D. Figure 1 shows the attempted versus achieved SE graphs for both groups, reflecting the close agreement between preoperative aims and postoperative outcomes.

Both toric IOL cohorts showed a statistically significant reduction in refractive cylinder after surgery (P = 0.001). Figure 2 details the distribution of postoperative astigmatism of both groups.

**FIGURE 1.** Spherical equivalent refraction, attempted versus achieved (D). A, Attempted versus achieved for spherical IOL group only. B, Attempted versus achieved for toric IOL group only.

**FIGURE 2.** Distribution of postoperative refractive cylinder.

**TABLE 1. Preoperative and Postoperative Refractive Data**

<table>
<thead>
<tr>
<th>Factors</th>
<th>Monofocal Toric IOL Group</th>
<th>Multifocal Toric IOL Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Range</td>
</tr>
<tr>
<td>Preoperative sphere</td>
<td>0.27 ± 2.26</td>
<td>−6.00 to 4.50</td>
</tr>
<tr>
<td>Preoperative cylinder</td>
<td>−0.67 ± 0.61</td>
<td>−1.50 to 0.00</td>
</tr>
<tr>
<td>Preoperative SE</td>
<td>−0.06 ± 2.24</td>
<td>−6.38 to 4.00</td>
</tr>
<tr>
<td>Preoperative keratometry</td>
<td>43.90 ± 1.36</td>
<td>41.52 to 47.15</td>
</tr>
<tr>
<td>Preoperative corneal cylinder</td>
<td>0.74 ± 0.21</td>
<td>0.40 to 1.18</td>
</tr>
<tr>
<td>Postoperative sphere</td>
<td>−0.26 ± 0.54</td>
<td>−2.25 to 1.00</td>
</tr>
<tr>
<td>Postoperative cylinder</td>
<td>−0.19 ± 0.30</td>
<td>−1.00 to 0.00</td>
</tr>
<tr>
<td>Postoperative SE</td>
<td>−0.33 ± 0.50</td>
<td>−0.75 to 0.50</td>
</tr>
<tr>
<td>Arithmetic difference from intended</td>
<td>−0.05 ± 0.44</td>
<td>−1.33 to 1.26</td>
</tr>
<tr>
<td>Absolute difference from intended</td>
<td>0.32 ± 0.29</td>
<td>0.00 to 1.33</td>
</tr>
</tbody>
</table>
Visual Acuity

Preoperatively, 38% of patients in the monofocal group achieved 20/20 corrected distance acuity. Approximately 80% of multifocal patients achieved corrected distance visual acuity of 20/20 or better, which reflects on the subset of patients demanding multifocal IOL implantation. Postoperatively, 60.3% and 68.2% of eyes achieved 20/20 or better uncorrected visual acuity in the monofocal and multifocal groups, respectively. As a measure of the multifocal IOL group, 70.5% of patients achieved N5 or better at 3 months after surgery. Figure 4 describes the postoperative uncorrected distance visual acuity (UDVA) for both groups and the uncorrected near visual acuity (UNVA) for the multifocal group.

DISCUSSION

The goal of optical independence after surgery has quickly become a focus for surgeons and patients. Advances in IOL technology have helped surgeons achieve these aims with greater accuracy and consistency. Available since the early 1990s,17 multifocal IOLs have shown good distance, intermediate, and

FIGURE 3. Preoperative (left) and postoperative (right) refractive astigmatism by corneal astigmatic correction.

FIGURE 4. Cumulative postoperative uncorrected visual acuity (distance top, near bottom).
near visual results across many published studies.\textsuperscript{18-20} Although astigmatic corrections have been incorporated in most multifocal models, most have a cylindrical power of 1.50 D or higher.\textsuperscript{21} Paradoxically, this limits patients who have low levels of corneal and refractive cylinder interested in achieving complete optical independence. With approximately two thirds of the population having corneal cylinder values of less than 1 D,\textsuperscript{8,9} a significant portion of patients may be left with residual refractive astigmatism after surgery if a spherical IOL is used.

Recently, Alcon has produced an IOL with a refractive cylindrical component of 1 D, which equates to 0.68 D at the corneal plane. In our retrospective assessment, we provide preliminary evidence to suggest that this lens can be used effectively in patients with low degrees of corneal astigmatism and report excellent visual results. A combined 64.3\% of patients obtained UDVA of 20/20 or better after surgery with the multifocal toric IOL. This compares well with Visser et al\textsuperscript{21} who provide an overview of recent toric IOL results, albeit with higher preoperative levels of astigmatism. In their review, between 5\% and 63\% of cases achieved UDVA of 20/20 or better. In our group, between 65\% and 70\% of patients had a residual cylinder of 0.25 D or less and 90\% had less than 0.5 D. These values compare favorably with previous studies; however, the comparison is mitigated again by the higher levels of preoperative cylinder in any comparison study. In isolation, however, there was a significant difference between preoperative and postoperative values in our toric group, which suggests that surgeons can expect to improve upon visual outcomes when using the low-powered toric lens.

There are several considerations for the use of toric IOLs. Misalignment of the IOL can lead to residual astigmatism.\textsuperscript{18} This may occur intraoperatively or after postoperative rotation of the IOL. Changes in IOL design and biomaterial have significantly reduced the relative instability of lenses.\textsuperscript{22} Accurate keratometry assessment, preoperative marking, and placement of the IOL will facilitate better postoperative results. Inherent errors in IOL calculations will also contribute to reducing the effectiveness of outcomes. Goggin et al\textsuperscript{23} recently identified an underestimation of the corneal plane cylinder power of the IOLs by the manufacturer's available calculation program. Koch et al\textsuperscript{12} outlined the potential influence of posterior corneal astigmatism on postoperative results. Identification of these artifacts in combination with new technology will likely see our results improve further.

There remain several options for correcting astigmatism in conjunction with cataract surgery. Intraoperative corneal relaxing incisions have been used extensively to treat astigmatism.\textsuperscript{24,25} The use of incisions can present several challenges, including the placement of incisions which may be technically difficult in certain meridians\textsuperscript{26} and induction of higher order aberrations. Grabow\textsuperscript{27} also highlights concerns with the long-term stability of the incisions. Furthermore, recent studies have suggested that toric IOLs will provide significantly better UDVA, improved contrast sensitivity, and more consistent results.\textsuperscript{28,29} Our results add to the current body of literature to suggest toric IOLs may represent a superior long-term option.

Our study has limitations. The sample is small and retrospective in nature. Larger, prospective trials will help confirm the putative benefits of this technology. Surgery was performed by 4 separate surgeons albeit following similar guidelines. This may have contributed to residual noise or artifacts within our observations.

This represents the first article to investigate the use of low-power toric multifocal IOLs. Before the development of low-power toric IOLs, patients with low to moderate amounts of astigmatism required concurrent intraoperative adjustments or additional forms of treatment to receive the full refractive benefits of cataract surgery. Evidence suggests that the ReSTOR T2 IOL now removes this barrier, providing consistent, accurate refractive and astigmatic results, and enables these patients to achieve excellent outcomes with a single treatment. Larger studies will help to consolidate our results.

ACKNOWLEDGMENTS
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REFERENCES


*Start by doing what’s necessary; then do what’s possible; and suddenly you are doing the impossible.*

— Francis of Assisi