ABSTRACT

PURPOSE: To compare the objective and subjective outcome of implantable collamer lenses (ICLs; Staar Surgical, Monrovia, CA) versus Veriflex lenses (AMO, Santa Ana, CA) for the correction of moderately high myopia.

METHODS: A prospective randomized comparative eye study was performed on 24 patients with bilateral myopia that ranged from -6 to -14.5 diopters (D). One eye was implanted with an ICL and the other eye was implanted with a Veriflex phakic intraocular lens (PIOL). Uncorrected distance visual acuity (UDVA), corrected distance visual acuity (CDVA), higher-order aberrations (HOAs), contrast sensitivity, patient satisfaction, central endothelial cell count, and PIOL centration were determined 6 months after surgery.

RESULTS: The logMAR UDVA and CDVA improved significantly in both groups (P < .001). There was no statistically significant difference in postoperative logMAR UDVA (P = .41) or logMAR CDVA (P = .36) between the two groups. Postoperative deviation from target refraction was -0.06 ± 0.41 D in the ICL group and -0.07 ± 0.49 D in the Veriflex group (P = .15). The difference in both induced and absolute postoperative HOAs between groups was not statistically significant. The area under the log contrast sensitivity function increased significantly in both groups postoperatively. The difference in patient satisfaction between both PIOLs was not statistically significant. A higher but statistically insignificant central endothelial cell count loss occurred in the Veriflex group (P = .11).

CONCLUSION: Both ICL and Veriflex PIOLs have equally satisfactory objective and subjective visual outcomes after surgery.

Phakic intraocular lenses (PIOLs) are used for correcting moderate and high ametropias and allowing maintenance of accommodation while offering good quality of vision, some reversibility of the procedure, and possible management of postoperative error.1-6

The Implantable Collamer Lens (ICL; Staar Surgical, Monrovia, CA) is a foldable posterior chamber PIOL that can be implanted through a 3.0-mm incision.7-16 The Veriflex lens (AMO, Santa Ana, CA) is an iris-claw lens with hydrophobic polysiloxane foldable design that can be implanted through a 3.2-mm incision.17-22 Implantation of both types of PIOLs is increasingly popular because it is technically undemanding while offering high predictability and a good safety profile.

Numerous studies have investigated the refractive results, safety profile, and complications of both types of PIOLs.7-22 Most of these studies focused on measurement of visual acuity and refraction, but with little emphasis on other visual functions such as contrast sensitivity and aberrations or subjective measures such as vision-related quality of life. In addition, little data are available about the objective and subjective visual outcome of each type in comparison to the other.

In the current study, we compared the objective and subjective visual outcomes after implantation of both types of PIOLs for the surgical correction of moderately high myopia using a prospective, randomized paired-eye design.

PATIENTS AND METHODS

The study was approved by the Cairo University research ethics committee and followed the tenets of the Declaration of Helsinki. A prospective interventional randomized study was conducted of 24 patients undergoing PIOL implantation from January 2010 through October 2011. Patients were included...
in the study if they had high myopia (manifest spherical equivalent more than 6 diopters [D]) and the difference in the manifest spherical equivalent between both eyes was less than 4 D. Because the highest power available in the Veriflex lens is -14.5 D, patients with myopia more than -14.5 D were excluded. In addition, patients with cylindrical error of 2.0 D or higher were excluded because toric PIOLs were not used in the current study. The target of surgery was emmetropia. The difference in the manifest spherical equivalent between both eyes was less than 4 D. Because the highest power available in the Veriflex lens is -14.5 D, patients with myopia more than -14.5 D were excluded. In addition, patients with cylindrical error of 2.0 D or higher were excluded because toric PIOLs were not used in the current study. The target of surgery was emmetropia. The order of the two methods and the eye that was treated were randomized with the use of a random-number table at the inclusion visit. Surgeries were performed by two surgeons (AA and AEH).

**ICL SURGICAL PROCEDURE**

Calculation of lens power was performed by the manufacturer using a modified vertex formula. The size of the IOL was chosen based on the horizontal corneal diameter and the anterior chamber depth measured with Pentacam tomography (Oculus Optikgeräte, Wetzlar, Germany). Two paracenteses were performed at the 6- and 12-o’clock positions. A viscoelastic substance was injected into the anterior chamber. A model V4b ICL was inserted through a 3-mm temporal clear corneal incision using an injector cartridge. The ICL was placed in the posterior chamber, the viscosurgical substance was completely washed out using balanced salt solution, and a miotic agent was injected into the anterior chamber. A peripheral iridectomy was performed using a vitrectomy cutter. Topical steroids and antibiotics were prescribed for 4 weeks after surgery.

**VERIFLEX LENS SURGICAL PROCEDURE**

Calculation of lens power was performed using the van der Heijde formula, which uses the spherical equivalent of the patient’s subjective refraction, the corneal curvature, and the anterior chamber depth. The corneal curvature and the anterior chamber depth were measured with Pentacam tomography. A 3.2-mm superior incision was constructed. Two vertical paracenteses were then performed at the 2- and 10-o’clock positions and directed to the enclavation area. An intracameral miotic agent and viscoelastic material were injected. The lens was inserted with a specially designed spatula that allows the surgeon to fold and insert the lens. The lens was then rotated 90 degrees into a horizontal position from the 3- to 9-o’clock positions. The lens was fixed with an enclavation needle to push the iris into both claws. The centration of the lens over the pupil was checked. A peripheral iridotomy was then performed using a vitrector. The viscoelastic material was removed with balanced salt solution, and the incision was left sutureless. Topical steroids and antibiotics were prescribed for 4 weeks after surgery.

**ASSESSMENT OF VISUAL ACUITY, OCULAR HIGHER-ORDER ABERRATIONS, AND CONTRAST SENSITIVITY**

Uncorrected distance visual acuity (UDVA), corrected distance visual acuity (CDVA), spherical equivalent, and the mean objective refractive cylinder power were evaluated before and 6 months after surgery. The deviation from target refraction was calculated.

Wavefront aberrations and contrast sensitivity were evaluated for a 4-mm pupil by Hartmann-Shack aberrometer (Ocular Wavefront Analyzer; SCHWIND eye-tech-solutions GmbH & Co.KG, Kleinostheim, Germany) before and 6 months after surgery. The root mean square of the third-order Zernike coefficients was used to represent coma-like aberrations, and the root mean square of the fourth-order coefficient was used to represent spherical-like aberrations. Total higher-order aberrations (HOAs) were calculated as the root mean square of the third- and fourth-order coefficients. Contrast sensitivity was always evaluated with refractive error, if any, corrected first using the Michelson formula. The area under the log contrast sensitivity function was calculated from the contrast sensitivity data. The log of contrast sensitivity was plotted as a function of the log of the special frequency, and third-order polynomials were fitted to the data. The fitted function was integrated between the fixed limits of 0.18 (corresponding to 1.5 cycles per degree) and 1.26 (corresponding to 16 cycles per degree). All examinations were performed by one experienced ophthalmic technician.

**SUBJECTIVE OUTCOME**

Patients were asked to rate their overall satisfaction with the surgical outcome on a five-category scale (very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied, and very dissatisfied). Patients were also asked to comment on the presence of any night vision symptoms (glare, halo, or starburst) before and after surgery.

**COMPLICATIONS**

Any significant complication such as cataract formation, pupillary block, pigment dispersion, or elevation of intraocular pressure was reported during the follow-up period.

The amount of decentration of the PIOL was determined by measuring the deviation of the center of the PIOL from the center of the pupil with the integrated pupillometry mode within the aberrometer. In addition, endothelial evaluation was done before and 6 months after surgery using a noncontact specular
microscope (Topcon SP 2000 P; Topcon, Nishinomiya, Hyogo, Japan). Endothelial cell density was evaluated at the center (triplicate measurement) to determine the central endothelial cell density.

**Statistical Analysis**

For statistical analyses, Snellen visual acuities were transformed to logMAR values and HOAs were transformed into absolute values. Wilcoxon signed rank test was used to compare the data for visual acuity, HOAs, contrast sensitivity, and patient satisfaction. The paired t-test was used to compare the data for continuous variables such as central endothelial cell density and spherical error. Correlations between the scale scores and clinical parameters were assessed with the Spearman rank correlation coefficient. Statistical analysis was performed using SPSS for Windows (SPSS, Inc., Chicago, IL).

### RESULTS

**Patient Population**

The mean age of patients was 29.1 ± 5.7 years (range: 25 to 34 years). Fifteen patients were female (62.5%). There were no significant differences between the two groups (Table 1) in terms of logMAR UDVA (P = .39), logMAR CDVA (P = .44), manifest spherical equivalent (P = .27), or manifest cylinder (P = .29). In addition, there were no significant differences between the two groups in terms of preoperative HOAs (P = .59 for third-order aberrations, P = .58 for fourth-order aberrations, and P = .49 for total HOAs for a 4-mm pupil) or area under the log contrast sensitivity function (P = .46).

**Visual Acuity and Refraction**

Mean preoperative UDVA improved significantly from 20/604 (range: 20/1000 to 20/400) preoperatively to 20/32 (range: 20/70 to 20/25) postoperatively in the

---

**Table 1**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Preoperative</th>
<th>Postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ICL Group</td>
<td>Veriflex Group</td>
</tr>
<tr>
<td>Manifest spherical equiva-</td>
<td>-11.48 ± 2.04</td>
<td>-10.97 ± 1.91</td>
</tr>
<tr>
<td>lent, mean ± SD (range)</td>
<td>(-7 to -14.50)</td>
<td>(7.50 to 14.00)</td>
</tr>
<tr>
<td>Manifest cylinder,</td>
<td>1.24 ± 0.90</td>
<td>1.29 ± 1.03</td>
</tr>
<tr>
<td>mean ± SD (range)</td>
<td>(0.0 to 2.00)</td>
<td>(0.0 to 2.00)</td>
</tr>
<tr>
<td>logMAR UDVA,</td>
<td>1.48 ± 0.18</td>
<td>1.42 ± 0.23</td>
</tr>
<tr>
<td>mean ± SD (range)</td>
<td>(1.78 to 1.18)</td>
<td>(1.78 to 1.0)</td>
</tr>
<tr>
<td>logMAR CDVA,</td>
<td>0.16 ± 0.17</td>
<td>0.17 ± 0.18</td>
</tr>
<tr>
<td>mean ± SD (range)</td>
<td>(0.53 to 0.55)</td>
<td>(0.55 to 0)</td>
</tr>
</tbody>
</table>

ICL = implantable collamer lens; SD = standard deviation; UDVA = uncorrected distance visual acuity; CDVA = corrected distance visual acuity.
The ICL is manufactured by Staar Surgical, Monrovia, CA, and the Veriflex lens is manufactured by AMO, Santa Ana, CA.
ICL group \((P < .001)\), and from \(20/526\) (range: \(20/1000\) to \(20/200\)) preoperatively to \(20/33\) (range: \(20/70\) to \(20/25\)) postoperatively in the Veriflex group \((P < .001)\) (Figure 1A). The logMAR CDVA also improved significantly from \(20/29\) (range: \(20/60\) to \(20/20\)) preoperatively to \(20/26\) (range: \(20/50\) to \(20/20\)) postoperatively in the ICL group \((P = .03)\) and from \(20/30\) (range: \(20/70\) to \(20/20\)) preoperatively to \(20/26\) (range: \(20/50\) to \(20/20\)) postoperatively in the Veriflex group \((P = .02)\) (Figure 1B). There was no statistically significant difference in logMAR UDVA \((P = .41)\) or logMAR CDVA \((P = .36)\) 6 months postoperatively between the two groups. In the ICL group, 9 of 24 eyes (37.5%) showed no change in CDVA, 9 eyes (37.5%) gained 1 line, and 6 eyes (25%) gained 2 lines. In the Veriflex group, 9 of 24 eyes (37.5%) showed no change in CDVA, 10 eyes (41.7%) gained 1 line, and 5 eyes (20.8%) gained 2 lines. No eye in either group lost lines of CDVA (Figure 2).

The manifest spherical equivalent changed significantly from \(-11.48 \pm 2.04\) D (range: \(-7\) to \(-14.50\) D) preoperatively to \(-0.35 \pm 0.83\) D (range: \(-1.25\) to \(+1.00\) D) 6 months postoperatively in the ICL group \((P < .001)\) and from \(-10.97 \pm 1.91\) D (range: \(-7.50\) to \(14.00\) D) preoperatively to \(-0.34 \pm 0.81\) D (range: \(-1.25\) to \(+0.75\) D) 6 months postoperatively in the Veriflex group \((P < .001)\). The manifest cylinder changed from \(1.24 \pm 0.90\) D (range: \(0\) to \(2.00\) D) preoperatively to \(1.15 \pm 0.80\) D (range: \(0\) to \(2.00\) D) postoperatively in the ICL group \((P = .08)\) and from \(1.29 \pm 1.03\) D (range: \(0\) to \(2.00\) D) preoperatively to \(1.19 \pm 0.94\) D (range: \(0\) to \(2.00\) D) postoperatively in the Veriflex group \((P = .09)\). There was no statistically significant difference in the postoperative manifest spherical equivalent \((P = .55)\) or manifest cylinder \((P = .31)\) between both groups.

Postoperative deviation from target refraction was \(-0.06 \pm 0.41\) D in the ICL group and \(-0.07 \pm 0.49\) D in the Veriflex group (Figure 3). The difference in the postoperative target deviation was not statistically significant \((P = .15)\). Only two patients in the ICL group
(8.3%) and three patients in the Veriflex group (12.5%) showed deviation from target refraction of more than 0.5 D (Figure 4).

**OCULAR HOAS**

Preoperative and postoperative HOAs for 4-mm pupil are summarized in Table 2. The difference in the preoperative HOAs between groups was not statistically significant. Following surgery, the mean inductions of third-order aberrations, fourth-order aberrations, and total HOAs were 0.01 ± 0.03 μm (range: -0.07 to 0.11 μm), 0.01 ± 0.01 μm (range: -0.02 to 0.02 μm), and 0.02 ± 0.03 μm (range: -0.08 to 10 μm), respectively, after ICL implantation. On the other hand, the mean inductions of third-order aberrations, fourth-order aberrations, and total HOAs were 0.01 ± 0.04 μm (range: -0.08 to 0.12 μm), 0.01 ± 0.01 μm (range: -0.01 to 0.02 μm), and 0.02 ± 0.04 μm (range: -0.07 to 0.11 μm), respectively, after Veriflex implantation. The difference in both the induced and absolute postoperative HOAs between groups was statistically insignificant. The correlation between the induced fourth-order aberrations and the manifest spherical equivalent correction in both groups was not statistically significant (Pearson correlation coefficient r = 0.02, P = .86 for the ICL group; r = 0.03, P = .85 for the Veriflex group).

**CONTRAST SENSITIVITY**

There was a statistically significant increase in the area under the log contrast sensitivity function in both groups after PIOL implantation (Table 3). The area increased from 1.33 ± 0.21 (range: 0.99 to 1.59) preoperatively to 1.48 ± 0.12 (range: 1.11 to 1.62) postoperatively in the ICL group and from 1.32 ± 0.19 (range: 0.98 to

### Table 2

**Summary of HOAs and Contrast Sensitivity Before and 6 Months After Surgery**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Preoperative ICL Group</th>
<th>Preoperative Veriflex Group</th>
<th>P</th>
<th>Postoperative ICL Group</th>
<th>Postoperative Veriflex Group</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Third order aberrations (μm), mean ± SD (range)</td>
<td>0.10 ± 0.04 (0.02 to 0.22)</td>
<td>0.11 ± 0.05 (0.02 to 0.24)</td>
<td>.21</td>
<td>0.11 ± 0.04 (0.02 to 0.24)</td>
<td>0.12 ± 0.06 (0.02 to 0.25)</td>
<td>.19</td>
</tr>
<tr>
<td>Fourth order aberrations (μm), mean ± SD (range)</td>
<td>0.05 ± 0.04 (0.01 to 0.15)</td>
<td>0.06 ± 0.04 (0.01 to 0.16)</td>
<td>.20</td>
<td>0.06 ± 0.04 (0.01 to 0.18)</td>
<td>0.06 ± 0.04 (0.01 to 0.17)</td>
<td>.17</td>
</tr>
<tr>
<td>Total HOAs (μm), mean ± SD (range)</td>
<td>0.11 ± 0.04 (0.03 to 0.23)</td>
<td>0.12 ± 0.05 (0.03 to 0.25)</td>
<td>.22</td>
<td>0.12 ± 0.04 (0.03 to 0.25)</td>
<td>0.13 ± 0.05 (0.03 to 0.26)</td>
<td>.28</td>
</tr>
<tr>
<td>CS (area under the log CS function), mean ± SD (range)</td>
<td>1.33 ± 0.21 (0.99 to 1.59)</td>
<td>1.32 ± 0.19 (0.98 to 1.56)</td>
<td>.46</td>
<td>1.48 ± 0.12 (1.11 to 1.62)</td>
<td>1.47 ± 0.11 (1.09 to 1.61)</td>
<td>.43</td>
</tr>
</tbody>
</table>

**Ocular HOAs**

Preoperative and postoperative HOAs for 4-mm pupil are summarized in Table 2. The difference in the preoperative HOAs between groups was not statistically significant. Following surgery, the mean inductions of third-order aberrations, fourth-order aberrations, and total HOAs were 0.01 ± 0.03 μm (range: -0.07 to 0.11 μm), 0.01 ± 0.01 μm (range: -0.02 to 0.02 μm), and 0.02 ± 0.03 μm (range: -0.08 to 10 μm), respectively, after ICL implantation. On the other hand, the mean inductions of third-order aberrations, fourth-order aberrations, and total HOAs were 0.01 ± 0.04 μm (range: -0.08 to 0.12 μm), 0.01 ± 0.01 μm (range: -0.01 to 0.02 μm), and 0.02 ± 0.04 μm (range: -0.07 to 0.11 μm), respectively, after Veriflex implantation. The difference in both the induced and absolute postoperative HOAs between groups was statistically insignificant. The correlation between the induced fourth-order aberrations and the manifest spherical equivalent correction in both groups was not statistically significant (Pearson correlation coefficient r = 0.02, P = .86 for the ICL group; r = 0.03, P = .85 for the Veriflex group).

**CONTRAST SENSITIVITY**

There was a statistically significant increase in the area under the log contrast sensitivity function in both groups after PIOL implantation (Table 3). The area increased from 1.33 ± 0.21 (range: 0.99 to 1.59) preoperatively to 1.48 ± 0.12 (range: 1.11 to 1.62) postoperatively in the ICL group and from 1.32 ± 0.19 (range: 0.98 to

### Table 3

**Contrast Sensitivity at Five Spatial Frequencies Before and 6 Months After PIOL Implantation**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Preoperative ICL Group</th>
<th>Preoperative Veriflex Group</th>
<th>P</th>
<th>Postoperative ICL Group</th>
<th>Postoperative Veriflex Group</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 cycles per degree</td>
<td>1.6 ± 0.4</td>
<td>1.6 ± 0.4</td>
<td>.63</td>
<td>1.6 ± 0.3</td>
<td>1.6 ± 0.3</td>
<td>.74</td>
</tr>
<tr>
<td>3 cycles per degree</td>
<td>1.9 ± 0.3</td>
<td>2.0 ± 0.4</td>
<td>.43</td>
<td>2.1 ± 0.3</td>
<td>2.2 ± 0.4</td>
<td>.30</td>
</tr>
<tr>
<td>6 cycles per degree</td>
<td>1.7 ± 0.3</td>
<td>1.6 ± 0.3</td>
<td>.29</td>
<td>1.9 ± 0.3</td>
<td>1.9 ± 0.3</td>
<td>.28</td>
</tr>
<tr>
<td>12 cycles per degree</td>
<td>1.2 ± 0.3</td>
<td>1.1 ± 0.3</td>
<td>.28</td>
<td>1.4 ± 0.3</td>
<td>1.4 ± 0.3</td>
<td>.32</td>
</tr>
<tr>
<td>18 cycles per degree</td>
<td>0.6 ± 0.3</td>
<td>0.7 ± 0.3</td>
<td>.25</td>
<td>0.7 ± 0.3</td>
<td>0.8 ± 0.3</td>
<td>.56</td>
</tr>
</tbody>
</table>

PIOL = phakic intraocular lens; ICL = implantable collamer lens

The ICL is manufactured by Staar Surgical, Monrovia, CA, and the Veriflex lens is manufactured by AMO, Santa Ana, CA.
1.56) preoperatively to 1.47 ± 0.11 (range: 1.09 to 1.61) postoperatively in the Veriflex group. There was also a significant increase in contrast sensitivity at all spatial frequencies (except at 1.5 cycles/degree) after PIOL implantation in both groups (Figure 5).

**PATIENT SATISFACTION**

Levels of patient satisfaction with surgery were high among both types of PIOLs (Figure 6). The difference in the level of satisfaction between both PIOLs was not statistically significant ($P = .96$). Night vision problems were reported in 8 patients (33%); none of the patients could attribute the problem to one eye more than the other.

**SECONDARY SURGERIES/ADVERSE EVENTS**

All surgeries were uneventful, and no significant complications such as cataract formation, pupillary block, or pigment dispersion were seen throughout the observation period.

The mean decentration of the PIOL was $0.41 \pm 0.22$ mm (range: 0.12 to 0.81 mm) for the ICL group and 0.39 ± 0.24 mm (range: 0.11 to 0.83 mm) for the Veriflex group. A total of 87.5% of ICLs and 83.3% of Veriflex lenses were placed within 0.5 mm of the center of the pupil.

Preoperatively, central endothelial cell density was $2,762 \pm 317$ cells/mm$^2$ in the ICL group and $2,757 \pm 341$ cells/mm$^2$ in the Veriflex group. The difference in the preoperative central endothelial cell density was statistically insignificant. After 6 months, the central endothelial cell density dropped to $2,715 \pm 304$ cells/mm$^2$ in the ICL group and to $2,581 \pm 277$ cells/mm$^2$ in the Veriflex group. Although the endothelial loss was higher with the Veriflex lens than the ICL, the difference did not reach statistical significance ($P = .11$).

**DISCUSSION**

In this study, we compared the objective and subjective outcome after ICL and Veriflex PIOL implantation for the correction of moderate-to-high myopia. There was no statistically significant difference in UDVA and CDVA between both types of PIOLs. Postoperative deviation from target refraction was minimal in both groups. Most patients were within 0.5 D of the target refraction. In addition, none of the patients showed loss of lines of CDVA, confirming a good safety index for both lenses. Prior studies demonstrated similar safety indices and predictability for both types of lenses.^{7-22} Boxer Wachler et al. conducted a study on 61 eyes to compare the refractive results of both types of lenses and reported similar findings.^{24} However, they reported better binocular visual acuity with ICL than with Veriflex PIOL. We were unable to investigate that in the current study because of the paired-eye comparison.
No adverse events were recorded during the follow-up period. Although the mean central endothelial cell loss was higher in the Veriflex lens, the difference was not statistically significant at the end of 6 months. Longer follow-up times are needed to confirm whether the difference would increase later on. The postoperative results of the central endothelial cell density and endothelial cell loss values in both groups are similar to those reported previously in the literature.13-20

Both objective and subjective evaluation of the quality of vision did not find any difference between lenses despite the diversity of the optic material and the position of the PIOL. The difference in induced HOA and the improvement in contrast sensitivity in both groups was not statistically significant. Prior studies have shown that the mean induced HOAs after implantation of both types of lenses are minimal, and have demonstrated improvement in contrast sensitivity following implantation of both types of lenses.25-31 The U.S. Food and Drug Administration ICL trial demonstrated no loss of contrast at any partial frequency and a significant improvement at 6 and 18 cycles per degree in mesopic contrast sensitivity without glare.15 The study also demonstrated a significant improvement for 4 of 5 spatial frequencies tested in contrast sensitivity with glare. Further studies reported an increase in contrast sensitivity with ICLs for the correction of both moderate and high myopia.25,30 Lombardo et al. demonstrated that contrast sensitivity under photopic conditions was increased after rigid Artisan lens implantation, but it was slightly decreased under mesopic conditions.31 Peris-Martínez et al. found that mesopic contrast sensitivity was slightly better with flexible iris-fixated lenses compared to rigid ones.28 However, these studies did not directly compare the HOAs and the contrast sensitivity of both lenses.

Our results are in line with these previous findings with a small increase in HOAs and an increase in contrast sensitivity after implantation of both types of lenses. We found the difference in induced HOAs and the postoperative increase in contrast sensitivity between both types of lenses to be not statistically significant. Although night vision problems were reported in 33% of patients, none of the patients were able to attribute it to one eye or the other.

Kamiya et al. postulated that the theoretical retinal magnification after PIOL implantation is 1.00 times compared to 0.92 times for spectacle correction for correction of moderate myopia.32 They assumed that this may result in approximately 0.34 logMAR line (1.7 letters) gained after PIOL implantation. They attributed the small increase in fourth-order aberrations to the retention of the unchanged corneal prolate shape and to the negative spherical aberration of PIOLs, and the slight increase in third-order aberrations to the corneal incision. In addition, they suggested that the small increase in the number of HOAs and the small decrease in retinal magnification may contribute to better visual performance, as evidenced by higher contrast sensitivity function, after PIOL implantation.

Both types of PIOLs have a foldable optical zone that allows insertion of the lens through a small incision. The original Artisan PIOL was made of polymethylmethacrylate and required a 6.2-mm corneal incision. The major concern with the refractive outcome of the rigid version of the PIOL was the induced astigmatism and longer rehabilitation that resulted from the larger incision.17 Veriflex, a foldable version of the Artisan lens, was developed with the haptics and optic still made of polymethylmethacrylate, whereas the optical zone is made of silicone, thus allowing folding and insertion of the lens through a 3.2-mm incision.

When ICL and Veriflex lenses were compared with the aim of correcting moderately high myopia that ranged from 6 to 14 D, both lenses were shown to provide equal visual performance and safety. Nevertheless, this observation needs to be supported by a larger cohort of patients and a longer follow-up.

**AUTHOR CONTRIBUTIONS**

Study concept and design (AA); data collection (AEH); analysis and interpretation of data (AA); drafting of the manuscript (AA); critical revision of the manuscript (AEH); statistical expertise (AA); administrative, technical, or material support (AEH); supervision (AEH)

**REFERENCES**

8. Sanders DR, Brown DC, Martin RG, Shepherd J, Deitz MR, DeLuca M. Implantable contact lens for moderate to high myopia:
ICL vs Veriflex Phakic IOLs/Awadein & Habib


