The evaluation of postoperative objective and subjective refraction for premium intraocular lenses

A avaliação da refração objetiva e subjetiva pós-operatória para lentes intraoculares premium

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ABSTRACT

Purpose: To evaluate six different premium IOLs retrospectively in respect to both subjective and objective refraction after cataract operation. Methods: Five hundreds and seventy eyes of 285 patients with bilateral cataract who had undergone phacoemulsification and IOL implantation operation between February 2017 and September 2018 were enrolled in this study. The mean age of the patients was 57.78 ± 7.49 (41-71) years. Out of 285 patients 137 were male (48.07%) and 148 were female (51.93%). The IOLs used were: RayOne Trifocal (Rayner, Worthing, UK), Lucidis (Swiss Advanced Vision, Neuchâtel, Switzerland), PanOptix (Alcon, Fort Worth, USA), LentisMplus (Oculentis, Berlin, Germany), Tecnis Symfony (Abbott, Illinois, USA) and Acriva Trinova (VSY Biotechnology, Istanbul, Turkey). Results: There were no significant differences among the groups regarding age, sex, axial length, the mean preoperative and postoperative uncorrected visual acuity (UCVA), best-corrected visual acuity (BCVA), the mean preoperative spherical equivalent (SE) and the mean postoperative SE (subjective measurement) (P> .05). The postoperative refractions measured with autorefractometer were more myopic than subjective refractions in all patients except the patients who had PanOptix IOL. In postoperative twelfth month, the mean UCVA arrived 0.00 logMAR in 405 eyes (78.48%); however, the mean autorefractometric measurement was -1.28 ± 1.02 (0.00_-2.75) D. Conclusion: The autorefractometer measurements of all patients who had premium IOLs except PanOptix IOL were not coherent with their visual acuities postoperatively. The ophthalmologists and/or optometrists should be careful while examining these types of patients.

Keywords: Lenses, intraocular; Objective refraction; Subjective refraction; Visual acuity

Resumo

Objetivo: Avaliar retrospectivamente seis diferentes LIOs premium em relação à refração subjetiva e objetiva após operação de catarata. Métodos: Quinhentos e setenta (570) olhos de 285 pacientes com catarata bilateral submetidos a facoemulsificação e operação de implantação de LIO entre fevereiro de 2017 e setembro de 2018 foram incluídos neste estudo. A média de idade dos pacientes foi de 57,78 ± 7,49 (41-71) anos. Dos 285 pacientes, 137 eram do sexo masculino (48,07%) e 148, do sexo feminino (51,93%). As seguintes IOLs foram utilizadas: RayOne Trifocal (Rayner, Worthing, Reino Unido), Lucidis (Swiss Advanced Vision, Neuchâtel, Suíça), PanOptix (Alcon, Fort Worth, EUA), LentisMplus (Oculentis, Berlim, Alemanha), Tecnis Symfony (Abbott, Illinois, EUA) e Acriva Trinova (VSY Biotechnology, Istambul, Turquia). Resultados: Não houve diferenças significativas entre os grupos em relação à idade, sexo, comprimento axial, média da acuidade visual não corrigida pré e pós-operatória, (AVNC), melhor acuidade visual corrigida (MABC), equivalente esférico pré-operatório médio (EE) e EE pós-operatório médio (medição subjetiva) (P > 0,05). As refrações pós-operatórias medidas com autorefratômetro foram mais miópicas do que as refrações subjetivas em todos os pacientes, exceto naqueles que usavam LIO PanOptix. No décimo segundo mês pós-operatório, a AVNC média chegou a 0,00 logMAR em 405 olhos (78,48%); no entanto, a medição autorefractométrica média foi de -1,28 ± 1,02 (0,00_-2,75) D. Conclusão: As medições autorefractométricas de todos os pacientes que usavam LIOs premium, exceto LIO PanOptix, não foram coerentes com suas acuidades visuais no pós-operatório. Oftalmologistas e/ou optometristas devem ter cuidado ao examinar pacientes com esses perfis.

Descritores: Lentes intraoculares; Refração objetiva; Refração subjetiva; Acuidade visual

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The authors declare no conflict of interest

Received for publication 24/6/2020 - Accepted for publication 14/10/2020.
The evaluation of postoperative objective and subjective refraction for premium intraocular lenses

**INTRODUCTION**

Cataract is the most widespread cause of preventable blindness in the world.(1,2) Approximately 4 million cataract operations are performed in Europe every year.(3,4) Surgical techniques that improve recovery and reduce complication rates have increased the number of cataract operations all over the world.(4,5) As the number of operations has increased, so have the demands on patients. In standard cataract operations, monofocal intraocular lenses are implanted, providing vision only for one type of focus. After the operation, generally patients need spectacles.(6) Most patients, however, want to see both near and far without using spectacles.(7)

Refractive measurement is one of the most frequent tests in ocular examinations. Monocular objective refractive measurements are made via autorefractometry and wavefront aberrometry.(8-10) Objective refractive measurements are compared with subjective refraction in many studies.(11-14) Although most autorefractometer measurements are safe and similar to subjective refraction, objective refraction alone is insufficient for prescription.(15,16) Subjective refraction is very important to determine the refractive status of the patient.(17,18)

In this study, six different premium intraocular lenses were evaluated retrospectively in respect to both subjective and objective refraction after cataract operation.

**METHODS**

The study protocol was approved by the local ethics committee (Necmettin Erbakan University, Faculty of Medicine Ethics Committee, Konya, Turkey) and conformed to the tenets of the Declaration of Helsinki. An informed written consent form was completed by each patient before the surgery.

Five hundred and seventy eyes of 285 patients with bilateral cataract who had undergone phacoemulsification and IOL implantation operation between February 2017 and September 2018 were enrolled in this study. The mean age of the patients was 57.78 ± 7.49 (41-71) years. Out of 285 patients 137 were male (48.07%) and 148 were female (51.93%). Patients who had any previous eye surgery, retinal and/or corneal disorders and astigmatism more than 1.00 diopter were excluded from the study.

This study used 6 different premium intraocular lenses: RayOne Trifocal (Rayner, Worthing, UK), Lucidis (Swiss Advanced Vision, Neuchâtel, Switzerland), PanOptix (Alcon, Fort Worth, USA), Lentis Mplus (Oculentis, Berlin, Germany), Tecnis Symfony (Abbott, Illinois, USA) and Acryva Trinova (VSY Biotechnology, Istanbul, Turkey). The characteristics of the six intraocular lenses are presented in Table 1.

RayOne group comprised 45 patients (90 eyes), of whom 21 were male (46.67%) and 24 female (53.33%), with a mean age of 59.71 ± 6.55 (45-69) years. Lucidis group comprised 48 patients (96 eyes), of whom 24 were male (50%) and 24 female (50%), with a mean age of 56.33 ± 4.39 (51-63) years. PanOptix group comprised 51 patients (102 eyes), of whom 24 were male (47.06%) and 27 female (52.94%), with a mean age of 57.24 ± 6.98 (41-67) years. Lentis Mplus group comprised 48 patients (96 eyes), of whom 23 were male (46.45%) and 25 female (53.55%), with a mean age of 59.18 ± 6.78 (49-71) years. Tecnis Symfony group comprised 45 patients (90 eyes), of whom 21 were male (46.67%) and 24 female (53.33%), with a mean age of 58.03 ± 6.13 (44-68) years. Acryva Trinova group comprised 48 patients (96 eyes), of whom 24 were male (50%) and 24 female (50%), with a mean age of 56.71 ± 6.36 (47-67) years.

Detailed anterior and posterior segment examinations were performed on all patients, including uncorrected visual acuity, best corrected visual acuity, intraocular pressure measurements and refractive measurements. Refractive measurements of all patients were performed with the Tonoref programme. Data are presented as mean ± standard deviation.

All of the surgeries were performed by the same surgeon (F.U.). Curvilinear continuous capsulorhexis, and hydrodissection were performed under topical anesthesia (proparacaine hydrochloride 0.5%) following a 2.4-mm corneal incision. After nucleus emulsification, irrigation and aspiration were performed, and then viscoelastic material was injected and the intraocular lens was implanted. After the aspiration of the viscoelastic material, the operation was completed.

Postoperatively, all patients used Maxidex (Dexamethasone 0.1%, Alcon, USA) 6x1, Vigamox (Moxifloxacin 0.5%, Alcon, USA) 4x1 for one week, and Acular LS (Ketorolac tromethamine 0.4%, Allergan, Ireland) 4x1 for one month. The steroid dosage was tapered and stopped at the end of one month.

All patients were examined post-operation on the first day, first week, first month, third month, sixth month and twelfth month. During those examinations, uncorrected visual acuity, best corrected visual acuity and autorefractive measurements were taken.

Statistical analysis was performed using SPSS version 22 programme. Data are presented as mean ± standard deviation with 95% Confidence Interval. Data was compared using the Chi-square test and One-way ANOVA test and to find out the group or groups causing difference, Tukey test was used. P<.05 was accepted as statistically significant.

**Table 1**

The characteristics of IOLs

<table>
<thead>
<tr>
<th>Model Name</th>
<th>RayOne</th>
<th>Lucidis</th>
<th>PanOptix</th>
<th>Lentis Mplus</th>
<th>Tecnis Symfony</th>
<th>Acryva Trinova</th>
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<tr>
<td>Model Number</td>
<td>RA0600C</td>
<td>108M</td>
<td>TFN700</td>
<td>LS-313</td>
<td>ZXR00</td>
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<td>Power Range (D)</td>
<td>-10.00 - +34.00</td>
<td>+5.00 - +30.00</td>
<td>+2.00 - +34.00</td>
<td>-10.00 - +36.00</td>
<td>+5.00 - +34.00</td>
<td>0.00 - +32.00</td>
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<td>Incision Size (mm)</td>
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<td>2.4</td>
<td>2.4</td>
<td>2.4</td>
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<td>Material</td>
<td>Hydrophilic</td>
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<td>Methacrylate</td>
<td>Hydrophilic</td>
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<tr>
<td></td>
<td>acrylic</td>
<td>acrylic</td>
<td>Copolymer</td>
<td>acrylic</td>
<td>acrylic</td>
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<td>Overall Length (mm)</td>
<td>12.50</td>
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<td>13.00</td>
<td>11.00</td>
<td>13.00</td>
<td>11.00</td>
</tr>
<tr>
<td>Optic Diameter (mm)</td>
<td>6.00</td>
<td>6.00</td>
<td>6.00</td>
<td>6.00</td>
<td>6.00</td>
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</tr>
</tbody>
</table>

Abbreviations: D; diopter, mm; milimeter.
RESULTS

There were no significant differences among the groups regarding age, sex and axial length (P>.05). There were no significant differences among the groups regarding the mean preoperative uncorrected visual acuity and best corrected visual acuity, the mean postoperative uncorrected visual acuity and best corrected visual acuity, the mean preoperative spherical equivalent and the mean postoperative spherical equivalent (subjective measurement) (P>.05). The mean postoperative 12-month spherical equivalent (objective measurement) of the RayOne group was significantly higher than that of the other groups, and the mean postoperative 12-month spherical equivalent (objective measurement) of the PanOptix group was significantly lower than that of the other groups (P<.05).

The postoperative autorefractometer measurements of all groups except the PanOptix group were not consistent with visual acuities. The autoreflective measurements for RayOne, Lucidis, Panoptix, LentisMplus, TecnisSymfony and Trinova intraocular lenses were approximately -2.50 D, -1.00 D, 0.00 D, 0.50 D, 1.50 D and -1.00 D, respectively. The refractions measured using autorefractometry were more myopic than subjective refractions in all patients except the patients who had the PanOptix intraocular lens. Twelve months post-operation, the mean autorefractometric measurement of all patients was -1.28 ± 1.02 (0.00 – 2.75) D, however, the mean uncorrected visual acuity was 0.00 logMAR in 405 eyes (78.48%).

The mean preoperative uncorrected visual acuity of the patients who had RayOne IOL was 0.80 ± 0.15 (0.60 – 1.00) logMAR and their mean postoperative 12th month uncorrected visual acuity was 0.07 ± 0.08 (0.00 – 0.10) logMAR. The mean preoperative spherical equivalent of this group was -1.75 ± 0.72 (0.50 – 3.25) D and the mean postoperative 12th month spherical equivalent of this group was -2.42 ± 0.23 (-2.00 – 2.75) D (objective measurement) and -0.24 ± 0.34 (-0.75 – 0.50) D (subjective measurement).

The mean preoperative uncorrected visual acuity of the patients who had Lucidis IOL was 0.82 ± 0.16 (0.60 – 1.10) logMAR and their mean postoperative 12th month uncorrected visual acuity was 0.06 ± 0.05 (0.00 – 0.10) logMAR. The mean preoperative spherical equivalent of this group was -1.59 ± 0.58 (0.25 – 2.25) D and the mean postoperative 12th month spherical equivalent of this group was -1.07 ± 0.14 (-0.25 – -1.50) D (objective measurement) and -0.22 ± 0.23 (-0.75 – 0.50) D (subjective measurement).

The mean preoperative uncorrected visual acuity of the patients who had PanOptix IOL was 0.81 ± 0.12 (0.60 – 0.90) logMAR and their mean postoperative 12th month uncorrected visual acuity was 0.04 ± 0.03 (0.00 – 0.10) logMAR. The mean postoperative spherical equivalent of this group was -1.62 ± 0.57 (0.25 – 3.00) D and the mean postoperative 12th month spherical equivalent of this group was -0.19 ± 0.08 (0.00 – 0.25) D (objective measurement) and -0.21 ± 0.19 (-0.75 – 0.50) D (subjective measurement).

The mean preoperative uncorrected visual acuity of the patients who had LentisMplus IOL was 0.86 ± 0.13 (0.70 – 1.00) logMAR and their mean postoperative 12th month uncorrected visual acuity was 0.02 ± 0.03 (0.00 – 0.10) logMAR.

Table 2

The preoperative and postoperative findings of the patients

<table>
<thead>
<tr>
<th></th>
<th>RayOneTrifocal Mean±SD with 95% CI</th>
<th>Lucidis Mean±SD with 95% CI</th>
<th>PanOptix Mean±SD with 95% CI</th>
<th>LentisMplus Mean±SD with 95% CI</th>
<th>TecnisSymfony Mean±SD with 95% CI</th>
<th>Trinova Mean±SD with 95% CI</th>
<th>P Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>59.71 ± 6.55 (45 - 69)</td>
<td>56.33 ± 4.39 (51 - 63)</td>
<td>57.24 ± 5.98 (41 - 67)</td>
<td>59.18 ± 6.78 (49 - 71)</td>
<td>58.03 ± 6.13 (44 - 68)</td>
<td>56.71 ± 6.36 (47 - 67)</td>
<td>=.26</td>
</tr>
<tr>
<td>Sex (Male / Female Ratio)</td>
<td>21 / 24 (46.67% / 53.33%)</td>
<td>24 / 24 (50% / 50%)</td>
<td>24 / 27 (47.06% / 52.94%)</td>
<td>23 / 25 (46.45% / 53.55%)</td>
<td>24 / 24 (50% / 50%)</td>
<td>24 / 24 (50% / 50%)</td>
<td>=.63</td>
</tr>
<tr>
<td>Axial Length</td>
<td>23.31 ± 0.92 (21.82 – 24.80)</td>
<td>23.08 ± 1.03 (21.59 – 24.90)</td>
<td>22.99 ± 0.68 (21.71 – 24.52)</td>
<td>23.16 ± 0.72 (21.81 – 24.51)</td>
<td>23.45 ± 0.81 (21.77 – 24.59)</td>
<td>23.34 ± 0.90 (21.23 – 24.77)</td>
<td>=.44</td>
</tr>
<tr>
<td>Preoperative SE</td>
<td>-1.75 ± 0.72 (0.50 – 3.25)</td>
<td>-1.59 ± 0.58 (0.25 – 2.25)</td>
<td>-1.62 ± 0.57 (0.25 – 3.00)</td>
<td>-1.65 ± 1.04 (0.25 – 3.75)</td>
<td>-1.58 ± 0.88 (0.25 – 3.25)</td>
<td>-1.72 ± 0.97 (0.25 – 3.50)</td>
<td>=.35</td>
</tr>
<tr>
<td>Postoperative SE</td>
<td>-2.42 ± 0.23 (0.00 – 2.75)</td>
<td>-1.07 ± 0.14 (-0.25 – -1.50)</td>
<td>-0.19 ± 0.18 (0.00 – 0.25)</td>
<td>-1.38 ± 0.19 (-1.00 – -2.00)</td>
<td>-1.36 ± 0.11 (-1.00 – -1.75)</td>
<td>-1.12 ± 0.18 (-0.50 – -1.25)</td>
<td>=.01</td>
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<tr>
<td>Postoperative SE</td>
<td>-0.24 ± 0.34 (-0.75 – 0.50)</td>
<td>-0.22 ± 0.23 (-0.75 – 0.50)</td>
<td>-0.21 ± 0.19 (-0.75 – 0.50)</td>
<td>-0.23 ± 0.43 (-0.75 – 0.50)</td>
<td>-0.23 ± 0.36 (-0.75 – 0.50)</td>
<td>-0.24 ± 0.41 (-0.75 – 0.50)</td>
<td>=.48</td>
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<tr>
<td>Preoperative UCVA</td>
<td>0.80 ± 0.15 (0.60 – 1.00)</td>
<td>0.82 ± 0.16 (0.60 – 1.10)</td>
<td>0.81 ± 0.12 (0.60 – 1.00)</td>
<td>0.86 ± 0.13 (0.70 – 1.00)</td>
<td>0.86 ± 0.11 (0.70 – 1.20)</td>
<td>0.83 ± 0.14 (0.60 – 1.00)</td>
<td>=.19</td>
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<tr>
<td>Postoperative UCVA</td>
<td>0.07 ± 0.08 (0.00 – 0.10)</td>
<td>0.06 ± 0.05 (0.00 – 0.10)</td>
<td>0.04 ± 0.03 (0.00 – 0.10)</td>
<td>0.07 ± 0.07 (0.00 – 0.10)</td>
<td>0.05 ± 0.05 (0.00 – 0.10)</td>
<td>0.07 ± 0.06 (0.00 – 0.10)</td>
<td>=.13</td>
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<tr>
<td>Preoperative BCVA</td>
<td>0.67 ± 0.23 (0.30 – 1.00)</td>
<td>0.71 ± 0.21 (0.30 – 1.00)</td>
<td>0.68 ± 0.22 (0.40 – 0.90)</td>
<td>0.70 ± 0.11 (0.50 – 0.80)</td>
<td>0.67 ± 0.19 (0.40 – 1.00)</td>
<td>0.69 ± 0.21 (0.40 – 1.00)</td>
<td>=.57</td>
</tr>
<tr>
<td>Postoperative BCVA</td>
<td>0.02 ± 0.04 (-0.10 – 0.10)</td>
<td>0.02 ± 0.03 (-0.10 – 0.10)</td>
<td>-0.01 ± 0.02 (-0.10 – 0.10)</td>
<td>0.01 ± 0.03 (-0.10 – 0.10)</td>
<td>-0.01 ± 0.03 (-0.10 – 0.10)</td>
<td>0.02 ± 0.03 (-0.10 – 0.10)</td>
<td>=.11</td>
</tr>
</tbody>
</table>

Abbreviations: SE; spherical equivalent, UCVA; uncorrected visual acuity, BCVA; best corrected visual acuity.
visual acuity was $0.07 \pm 0.07$ (0.00 - 0.10) logMAR. The mean preoperative spherical equivalent of this group was $-1.65 \pm 1.04$ (0.25 - 3.75) D and the mean postoperative 12th month spherical equivalent of this group was $-1.38 \pm 0.19$ (-1.00 - 2.00) D (objective measurement) and $-0.23 \pm 0.43$ (-0.75 – 0.50) D (subjective measurement).

The mean preoperative uncorrected visual acuity of the patients who had Tecnis Symfony IOL was $0.86 \pm 0.11$ (0.70 - 1.22) logMAR and their mean postoperative 12th month uncorrected visual acuity was $0.05 \pm 0.05$ (0.00 - 0.10) logMAR. The mean preoperative spherical equivalent of this group was $-1.58 \pm 0.88$ (0.25 - 3.25) D and the mean postoperative 12th month spherical equivalent of this group was $-1.36 \pm 0.11$ (-1.00 - 1.75) D (objective measurement) and $-0.23 \pm 0.36$ (-0.75 – 0.50) D (subjective measurement).

The mean preoperative uncorrected visual acuity of the patients who had AcrySof PanOptix IOL was $0.82 \pm 0.14$ (0.60 - 1.00) logMAR and their mean postoperative 12th month uncorrected visual acuity was $0.07 \pm 0.06$ (0.00 - 0.10) logMAR. The mean preoperative spherical equivalent of this group was $-1.72 \pm 0.97$ (0.25 - 3.50) D and the mean postoperative 12th month spherical equivalent of this group was $-1.12 \pm 0.18$ (-0.50 – 1.50) D (objective measurement) and $-0.24 \pm 0.41$ (-0.75 – 0.50) D (subjective measurement).

The preoperative and postoperative findings of the patients are presented in Table 2.

**Discussion**

Previous studies have reported that spectacle prescriptions made according to subjective refraction are better than those made with objective autorefractometry. Segura et al. evaluated the intraoperator repeatability in healthy subjects using the WAM-5500 auto-keratorefractometer and the iTrace aberrometer, to compare the refractive values and the subjective refraction. They reported that the iTrace aberrometer and the WAM-5500 auto-keratorefractometer showed high levels of repeatability in healthy eyes and refractive corrections with the aberrometer, the autorefractometer and subjective methods showed similar results, however, spherocylindrical subjective correction was the most frequently preferred method. These technologies could be used as complements in refractive evaluation, but they should not replace subjective refraction. McGinnigle et al. compared the validity and repeatability of the autorefract function of the Nidek OPD-Scan III with noncycloplegic subjective refraction. The Nidek OPD-Scan III gave slightly more negative readings than results of subjective refraction.

Ferreira et al. compared clinical outcomes and subjective experience after bilateral implantation of two trifocal intraocular lenses, RayOne Trifocal and the FineVision POD F. The mean UDVA was $0.03 \pm 0.11$ logMAR for RayOne and $0.04 \pm 0.08$ logMAR for FineVision POD F. Both intraocular lenses provided good visual outcomes at all distances with no differences between the groups. Refractive accuracy was better for the RayOne Trifocal intraocular lens. Gillmannet al. assessed the visual performance, clinical outcomes, and patient satisfaction after implantation of Lucidis intraocular lens. At 3 months postoperatively, the mean uncorrected distance, intermediate and near visual acuities were 0.2 logMAR, 0.07 logMAR and 0.15 logMAR, respectively. The mean best corrected visual acuity was 0.05 logMAR for distance and 0.03 logMAR for near vision. The mean spherical equivalent at 3 months postoperative was $-0.2 \pm 0.80$ D. They reported that the Lucidis intraocular lens demonstrated a good safety profile, with a low complication rate. While the uncorrected visual performance of this new optical design was worse than that of other extended depth of focus intraocular lenses for distance vision, it was better in intermediate and near vision, with consistently near-normal contrast sensitivity. Interestingly, self-reported spectacle independence and subjective patient satisfaction were high for all distances.

Ruiz-Mesa et al. compared the visual outcomes and ocular performance of the Pan Optix trifocal intraocular lens and Symfony intraocular lens. The visual outcomes for PanOptix and Symfony intraocular lens groups, respectively, were as follows: best corrected distance visual acuity $-0.03 \pm 0.03$ and $-0.02 \pm 0.03$ logMAR; distance corrected intermediate visual acuity at 80 cm: 0.06 $\pm 0.06$ and 0.06 $\pm 0.04$ logMAR; distance corrected intermediate visual acuity at 60 cm: 0.06 $\pm 0.10$ and 0.05 $\pm 0.04$ logMAR; distance corrected near visual acuity: 0.04 $\pm 0.06$ and 0.20 $\pm 0.07$ logMAR. Similar preferred reading distances were found for both groups (37.0 $\pm 4.6$ and 38.9 $\pm 5.7$ cm, respectively). The visual acuities at those distances were 0.09 $\pm 0.08$ and 0.19 $\pm 0.08$ logMAR respectively. The mean postoperative spherical equivalent was $0.03 \pm 0.19$ D for PanOptix group and $0.24 \pm 0.19$ D for Symfony group. They concluded that the PanOptix and Symfony intraocular lenses showed comparable visual performance at distance and intermediate. However, the PanOptix intraocular lens provided better near and preferred reading distance visual acuities and showed a more continuous range of vision than the Symfony intraocular lens.

García-Pérez et al. reported the short-term visual outcomes of AcrySof PanOptix intraocular lens, they stated that mean binocular uncorrected visual acuity in photopic conditions was 0.03 LogMAR for far, 0.12 for intermediate and 0.02 for near distances. All patients had uncorrected visual acuity better than 0.3 LogMAR for distance and near vision and 94.8% of patients for intermediate vision. Mesopic binocular uncorrected visual acuity values were similar to photopic values. Mean postoperative spherical equivalent was $-0.10$ D $\pm 0.26$ D. They concluded that the PanOptix trifocal intraocular lens provided good short-term visual outcomes, with good intermediate performance and excellent patient-reported satisfaction. The similar values achieved in mesopic and photopic conditions in binocular uncorrected visual acuity and contrast sensitivity suggested low pupillary dependence for light distribution.

Albarrán-Diego et al. evaluated the clinical utility of automated refraction and keratometry compared with subjective or manifest refraction after cataract or refractive lens exchange surgery with implantation of Lentis Mplus X multifocal intraocular lens. They observed excellent repeatability of the AR measurements. Linear regression of automated refraction versus MR showed good correlation for sphere and spherical equivalent, whereas the correlation for astigmatism was low. The mean difference automated refraction-manifest refraction was $-1.28 \pm 0.29$ D for sphere. Astigmatism showed better correlation between keratometry and manifest refraction. They suggested automated refraction sphere plus 1.25 D and the keratometry cylinder as the starting point for MR in eyes with a Lentis Mplus X multifocal intraocular lens. Hogarty et al. compared visual acuity, range of vision and spectacle independence in monofocal and extended range of vision intraocular lenses. They tested associations between intraocular lens type (ZA9002 Tecnis 3-piece or TecnisZCT monofocal; and Tecnis Symfony extended range of vision intraocular lense) and visual acuity. The postoperative spherical equivalent for Tecnis Symfony was $-0.19 \pm 0.44$ and uncorrected visual acuity
was 0.04±0.11 logMAR. They concluded that the extended range of vision intraocular lens, targeted to achieve monovision, demonstrated superior range of visual acuity and spectacle independence compared to the monofocal targeted to achieve emmetropia. To our knowledge, we did not encounter any studies related to the Acryva Trinova intraocular lens in the literature.

In all these studies, except Albarrán-Diego’s study(26), related to specific intraocular lenses mentioned above, the authors reported visual acuities and subjective or manifest refraction of the patients, they did not report the objective or autorefractometer refraction, neither the difference between objective and subjective refractions, however, in our study we emphasized on the difference between objective and subjective refractions and thereby coherence with uncorrected visual acuity postoperatively in patients who had premium intraocular lenses.

Kretzet al.(28) reported that further developments in the field of intraocular lenses offer a higher level of spectacle independence for the patients. As light gets scattered on different focal points, a widerrange of defocus is created. This greater defocus area makes it more difficult to determine the objective or subjective refraction. This is concerned with the difficulties of measuring visual acuity in different intraocular lens designs and different measurement distances. Measuring refraction after implantation of a multifocal intraocular lens is a complex procedure and the experience of the examiner plays a crucial role. Retinoscopy, keratometry and the defocus curve are reliable methods for testing, while the autorefractometer, bichromatic testing and the crosscylinder have limitations.

In conclusion, except for the case of the PanOptix intraocular lens, the autorefractometer measurements of all patients who had premium intraocular lens were not consistent with their visual acuities post-operatively. Consequently, ophthalmologists and/or optometrists should be careful while examining these types of patients.

Acknowledgements

The authors declare no financial disclosures and no conflicts of interests.

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