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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%). TheIOLsusedare: RayOne Trifocal (Rayner, Worthing, UK), Lucidis (Swiss Advanced Vision, Neuchâtel, Switzerland), PanOptix (Alcon, Fort Worth, USA), LentisMplus (Oculentis, Berlin, Germany), TecnisSymfony (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), TecnisSymfony (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 (MAVC), 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 míopes 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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Introduction

Cataract is the most widespread cause of preventable blindness in the world.[1,2]Approximately 4million cataract operations are performed in Europe every year.[3]Surgical techniques that improve recovery and reduce complication rateshave 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 wavefrontaberrometry.[8-10] Objective refractive measurements are compared with subjective refraction in many studies.[11-14] Although mostautorefractometer measurements are safe and similar tosubjective 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 (NecmettinErbakan 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 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%). Patients who had any previous eye surgery, retinal and/or corneal disorders and astigmatism more than 1.00diopter 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), LentisMplus (Oculentis, Berlin, Germany), TecnisSymfony (Abbott, Illinois, USA) and AcrivaTrinova (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 mean age of 57.24 ± 6.98 (41- 67) years. LentisMplus 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 Symphony group comprised 45 patients (90 eyes), of whom 21of were male (46.67%) and 24 female (53.33%), with mean age of 58.03 ± 6.13 (44 - 68) years. AcrivaTrinova group comprised 48 patients (96 eyes), of whom24 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 II autorefractometer (Nidek, Aichi, Japan), and biometric measurements were performed with Nidek Biometry (Nidek, Aichi, Japan). Holladay formula was used for the biometric measurements.

All of the surgeries were performed by the same surgeon (F.U.). Curvilinear continuous capsulorhexis, and hydrodissection were performedunder 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-operationon the first day, first week, first month, third month, sixth month and twelfth month. During those examinations, uncorrected visual acuity, best corrected visual acuity andautorefractive measurements were taken.

Statistical analysis was performed using SPSS version 22programme. 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 charactheristics of IOLs

Model Name	RayOne	Lucidis	PanOptix	Lentis Mplus	Tecnis Symfony	AcrivaTrinova
Model Number	RA0600C	108M	TFNT00	LS-313	ZXRO0	-
Power Range (D)	-10.00 - +34.00	+5.00 - +30.00	+2.00 - +34.00	-10.00 - +36.00	+5.00 - +34.00	0.00 – +32.00
Incision Size (mm)	2.4	2.4	2.4	2.4	2.4	2.4
Material	Hydrophilic acrylic	Hydrophilic acrylic	Methacrylate Copolymer	Hydrophilic acrylic	Hydrophilic acrylic	Hydrophilic acrylic
Overall Length (mm)	12.50	10.80	13.00	11.00	13.00	11.00
Optic Diameter (mm)	6.00	6.00	6.00	6.00	6.00	6.00

Abbrevations: 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 themean 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-monthspherical equivalent (objective measurement) of the RayOne group was significantly higher than thatof 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 postoperativeautorefractometer measurements of all groups except the PanOptix group were not consistent with visual acuities. The autorefractive measurements for RayOne, Lucidis, Panoptix, LentisMplus, TecnisSymfony and Trinova intraocular lenses were approximately -2.50 D, -1.0 D, 0.0 D, -1.50 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 PanOptixintraocular 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 acuitywas 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 acuityof 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 preoperative 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

Table 2
The preoperative and postoperative findings of the patients

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

Abbrevations: SE; spherical equivalent, UCVA; uncorrected visual acuity, BCVA; best corrected visual acuity.

visual acuity was 0.07 ± 0.07 (0.00 - 0.10)logMAR. The mean preoperative spherical equivalent of this group was -1.65 ± 1.04 (0.25 _ -3.75) D and the mean postoperative 12th month spherical equivalent of this group was -1.38 ± 0.19 (-1.00 _ -2.00) D (objective measurement) and -0.23 ± 0.43 (-0.75 – 0.50) D (subjective measurement).

The mean preoperative uncorrected visual acuityof the patients who had TecnisSymfony IOLwas0.86±0.11 (0.70 - 1.22) logMAR and their mean postoperative 12th month uncorrected visual acuity was 0.05 ± 0.05(0.00 - 0.10) logMAR. The mean preoperative spherical equivalent of this group was -1.58 ± 0.88 (0.25 _ -3.25) D and the mean postoperative 12th month spherical equivalent of this group was -1.36 ± 0.11 (-1.00 _ -1.75) D (objective measurement) and -0.23 ± 0.36 (-0.75 – 0.50) D (subjective measurement).

The mean preoperative uncorrected visual acuityof the patients who had AcrivaTrinova IOL was 0.83±0.14 (0.60 - 1.00) logMAR and their mean postoperative 12th month uncorrected visual acuitywas 0.07 ± 0.06 (0.00 - 0.10) logMAR. The mean preoperative spherical equivalent of this group was -1.72 ± 0.97 (0.25 _ -3.50) D and the mean postoperative 12th month spherical equivalent of this group was -1.12± 0.18 (-0.50 _ -1.50) D (objective measurement) and -0.24 ± 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 havereported that spectacle prescriptions made according to subjective refraction are better than those made with objective autorefractometry.[19]Segura et al.[20]evaluated the intraoperator repeatability in healthy subjects using the WAM-5500 auto-keratorefractometer and the iTrace aberrometer, to compare the refractive values and the subjectiverefraction. 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 mostfrequently preferred method. These technologies could be used as complements in refractive evaluation, but they should not replace subjective refraction.Mcginnigle et al.[21]compared the validity and repeatability of the autorefraction 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.[22]compared clinical outcomes and subjective experience after bilateral implantation of two trifocal intraocularlenses, Ray OneTrifocal and the FineVision POD F. The mean UDVA was 0.03±0.11 logMAR for RayOne and 0.04 ± 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.[23]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 ± 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 lensesfor 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-Mesaet al.[24]compared the visual out comes and ocular optical performance of thePan Optixtrifocal intraocular lens and Symfony intraocular lens.The visual outcomes for PanOptix and Symfony intraocular lensgroups, respectively, were as follows: best corrected distance visual acuity: -0.03 ± 0.03 and -0.02 ± 0.03 logMAR; distance corrected intermediate visual acuity at 80 cm: 0.06 ± 0.06 and 0.06 ± 0.04 logMAR; distance corrected intermediate visual acuity at 60 cm: 0.06 ± 0.10 and 0.05 ± 0.04 logMAR;distance corrected near visual acuity: 0.04 ± 0.06 and 0.20 ± 0.07 logMAR. Similar preferred reading distances were found for both groups (37.0 ± 4.6and 38.9 ± 5.7 cm, respectively). The visual acuities at those distances were 0.09 ± 0.08 and 0.19 ± 0.08 logMAR,respectively. The mean postoperative spherical equivalent was 0.03±0.19 D for PanOptix group and -0.24±0.19 D for Symfony group.They concluded thatthe 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 theSymfony intraocular lens. García-Pérez et al.[25] 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 distanceand 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 ± 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 acuityand contrast sensitivity suggested low pupillary dependence for light distribution.

Albarrán-Diegoet al.[26]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 LentisMplus 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 astigmatismwas low. The mean difference automated refraction-manifest refraction was -1.28±0.29 D for sphere. Astigmatism showedbetter 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. Hogartyet al.[27] compared visual acuity, range of vision and spectacle independencein monofocal and extended range of vision intraocular lenses.Theytested associations between intraocular lens type (ZA9002 Tecnis 3-piece or TecnisZCT monofocal; and TecnisSymfony extended range of visionintraocular lense) and visual acuity.The postoperative spherical equivalent for Tecnis Symfony was -0.19±0.44 and uncorrected visual acuity

was 0.04±0.11 logMAR.They concluded thatthe extended range of visionintraocular lens, targeted to achieve micromonovision, demonstrated superior range of visual acuity and spectacleindependence compared to the monofocal targeted to achieve emmetropia. To our knowledge, we did not encounter any studies related to the AcrivaTrinova 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 determinethe objective or subjective refraction. This is concerned with the difficulties of measuring visual acuity in different intraocular lensdesigns and different measurement distances. Measuring refraction after implantation of a multifocal intraocular lensis 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 PanOptixintraocular lens, the autorefractometer measurements of all patients who had premium intraocular lenswere not consistent with their visual acuities post-operatively. Consequently, ophthalmologists and/or optometrists should be careful while examining these types of patients.

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