Short-Term Changes in Prediction Error after Cataract Surgery in Eyes Receiving 1 of 3 Types of Single-Piece Acrylic Intraocular Lenses

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• PURPOSE: To compare short-term changes in refractive prediction error (PE) after phacoemulsification among eyes receiving different types of single-piece acrylic intraocular lenses (IOLs).

• DESIGN: Randomized clinical trial.

• METHODS: A total of 195 eyes of 195 patients scheduled for implantation of a single-piece acrylic IOL were randomly assigned to receive 1 of 3 IOLs: 1) an Alcon model SN60WF, 2) a Hoya model XY-1, or 3) an AMO model ZCB00V. Manifest spherical equivalent (MRSE) value, PE, and changes in PE were examined at 1 day and at 1 and 2 months postoperatively and were compared among groups.

• RESULTS: The mean MRSE and PE significantly changed toward myopia between 1 day and 2 months postoperatively in all groups ($P < .0001$). The MRSE and PE did not differ significantly among groups at 1 day and 1 month postoperatively and were significantly smaller in the SN60WF group than in the XY-1 and ZCB00V groups at 2 months ($P \leq .0006$). The PE change between 1 day and 2 months postoperatively was significantly smaller in the SN60WF group than in the other groups ($P = .0062$). IOL type and changes in anterior chamber depth and corneal curvature independently correlated with PE changes.

• CONCLUSIONS: The MRSE and PE showed a significant myopic change for 2 months postoperatively in eyes implanted with 1 of 3 types of single-piece acrylic IOLs and were significantly smaller in the SN60WF than in the XY-1 and ZCB00V groups. Changes in PE during the 2 postoperative months were smaller in the SN60WF IOLs than in the other IOLs, suggesting that postoperative refractive stability differs among single-piece acrylic IOLs. (Am J Ophthalmol 2020;219: 12–20. © 2020 Elsevier Inc. All rights reserved.)

REFRACTIVE PREDICTION ERROR (PE) IS CURRENTLY the most common complication after cataract surgery. Recently, the use of new ocular biometry devices and intraocular lens (IOL) power calculation formulas have reduced the postoperative refractive error,[1-8] but the PE frequently becomes much greater than expected. Particularly, surgeons are concerned with changes in PE over time in the immediate and early postoperative periods.

Refractive states change toward myopia immediately or early after cataract surgery.[9-14] Specifically, many reports indicate that eyes receiving a multipiece acrylic IOL exhibit a significant change toward myopia, whereas eyes that received a single-piece acrylic IOL do not show a significant refractive change.[9-13] Such myopic changes with multipiece acrylic IOLs are assumed to be due to an anterior IOL shift and a change in the corneal curvature.[9-19] Whether refractive states and PE change even in eyes implanted with single-piece acrylic IOLs has not been examined until now, despite the popularity of these single-piece acrylic IOLs and the substantial number of IOL models on the market.

The purpose of this study was to examine whether refraction and PE significantly change in eyes implanted with 1 of 3 types of single-piece acrylic IOLs and to examine whether the short-term changes in refraction and PE differ among these IOLs. Furthermore, to clarify the mechanisms underlying the differences in changes in PE among these IOLs, this study investigated the factors that significantly affect the changes in PE by using a general linear model analysis.

SUBJECTS AND METHODS

• **STUDY DESIGN:** This study was a randomized clinical trial conducted at the Hayashi Eye Hospital, Fukuoka, Japan, between June 2019 and January 2020. The study protocol was approved by the Institutional Review Board of the Hayashi Eye Hospital on June 26, 2019. All participants received an explanation of the nature of the study and provided written informed consent to participate. The study protocol adhered to the tenets of the Declaration of Helsinki. This study is registered in the University Hospital Medical Information Network (UMIN000039844).

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• **PARTICIPANTS:** All consecutive patients who were scheduled for phacoemulsification and implantation of single-piece hydrophobic acrylic IOL were screened for enrollment in the study beginning on June 27, 2019. The eye of each patient with better corrected distance visual acuity, or the right eye when the corrected distance visual acuities were the same between eyes, was enrolled in the study. Only eyes undergoing their first cataract surgery by 2 surgeons (K.H., M.Y.) were included, and eyes that had been included in other studies were excluded from the present study. Exclusion criteria were eyes with corneal disorders; eyes with vitreous opacity or retinal disease; eyes with ocular surface dryness; eyes scheduled for extracapsular or intracapsular cataract extraction; a history of ocular surgery or inflammation; eyes with pseudoexfoliation; eyes with a pupil diameter <4.0 mm after mydriasis; eyes with marked irregular corneal astigmatism; eyes of patients who refused to participate; and any anticipated difficulties with examination or the 2-month follow-up. Patient recruitment was continued until 195 eyes (65 eyes in each of the 3 IOL groups) were enrolled in the study, with the last eye enrolled on December 10, 2019.

• **IOL POWER CALCULATION:** The axial length of each eye was measured using the IOLMaster 700 (Carl Zeiss Meditec GmbH, Jena, Germany). The corneal curvature values at the steepest (Ks) and flattest (Kf) meridians of the total cornea were measured using anterior segment-optical coherence tomography (OCT) (Casia 2; Tomey, Tokyo, Japan), and the average value of both meridians (Ave K) was used for the IOL power calculation. IOL power was calculated using the Sanders-Retzlaff-Kraff theoretic formula with A-constants that were optimized for each IOL type.[20] The single-piece hydrophobic acrylic IOLs implanted were the AcrySof SN60WF (Alcon Laboratories, Ft. Worth, Texas), the XY-1 (Hoya, Tokyo, Japan), and the Tecnis ZCB00V (Abbot Medical Optics, Santa Ana, California). The SN60WF and ZCB00V IOLs were implanted through an approximately 2.4-mm incision, and the XY-1 IOL was implanted through an approximately 2.0-mm incision. The optimized A-constant was determined according to the axial length as described previously.[21-23]

• **RANDOMIZATION:** The day before surgery, each of the 195 patients were randomly assigned to receive 1 of 3 IOL groups 1) eyes that were to receive the SN60WF IOLs; 2) eyes that were to receive the XY-1 IOLs; and 3) eyes that were to receive the ZCB00V IOLs. The ophthalmic technician in charge generated a randomization code with equal numbers using computer software and assigned each patient to 1 of the 3 groups according to the randomization code. The operating room staff in charge was informed of the group to which each patient was assigned. The surgeon was informed by the staff of the IOL to be implanted before surgery. The technician in charge kept the assignment concealed until all data were collected. Patients, examiners, and data analysts were unaware of the assignment schedule.

• **SURGICAL TECHNIQUES:** Two surgeons (K.H., M.Y.) performed all surgeries using similar surgical procedures as described previously.[24] First, a continuous curvilinear capsulorrhexis measuring approximately 5.0 mm in diameter was accomplished using a bent needle. After continuous curvilinear capsulorrhexis, a clear corneal or transconjunctival corneoscleral incision was made using a 2.0- to 2.4-mm steel keratome. Following hydrodissection, phacoemulsification of the nucleus and cortical aspiration were performed using a phacoemulsifier (Centurion; Alcon). Without wound enlargement, the lens capsule was inflated with 1% sodium hyaluronate (Healon; AMO or Hyaguard; Nitten, Tokyo, Japan). The IOL was placed into the capsular bag using each manufacture's specific IOL injector. After IOL insertion, the viscoelastic material was thoroughly evacuated. No sutures were placed in any case.

• **OUTCOME MEASUREMENTS:** All patients underwent examinations before surgery and at 1 day and 1 and 2 months after surgery. Refractive spherical and cylindrical powers were measured objectively using an autorefractometer (Tonoref II or III; NIDEK, Gamagori, Japan). The dioptric steps of the Tonorefs II and III were set to 0.01 diopter (D). To precisely measure refractive states, automated capture of 3 measurements was repeated at least 4 times, and the mean value was used for analysis. The Tonoref shows a specific reliability index of each measurement ranging from 5 to 9, with 9 being the most reliable. When the optic medium is not clear due to corneal edema, anterior chamber inflammation, or cataract, the reliability index decreases. In the present study, only measurement values with a high reliability index of 8 and 9 were included in the analysis. Manifest spherical equivalent value (MRSE) was determined as the spherical power plus half the cylindrical power. The PE after cataract surgery was defined as the difference between the preoperative formula-predicted MRSE using that IOL power (preoperative target refraction) and the postoperative MRSE. The median absolute value of the PE was also calculated.

As possible factors correlating with the postoperative change in the PE, 5 endpoints were examined. Axial length was measured using the IOLMaster 700 (Zeiss). Anterior chamber depth and curvature indices of the total cornea were examined using the Casia 2 (Tomey). Central corneal thickness and central retinal thickness were measured using OCT (Cirrus HD-OCT plus 5000; Zeiss). Corrected distance visual acuity was measured on decimal charts and converted to the logarithm of the minimal angle of resolution (logMAR) scale for statistical analysis. All examinations were performed by experienced ophthalmic technicians unaware of the purpose of the study.

TABLE 1. Baseline Characteristics of the the Eyes that Received the Alcon Sn60WF (Sn60WF Group), HOYA XY-1 (XY-1 Group), and AMO ZCB00V (ZCB00V Group) IOL

Characteristics	Sn60WF Group (n = 63)	XY-1 Group (n = 65)	ZCB00V Group (n = 64)	*P* Value
Mean ± SD age	70.5 ± 8.0	69.2 ± 4.0	68.3 ± 4.7	.1708
Male/females	27/36	28/37	23/41	.6456
Mean ± SD corneal astigmatism (D)	0.79 ± 0.45	0.77 ± 0.5	0.82 ± 0.47	.8105
Mean ± SD MRSE (D)	-0.41 ± 3.63	-0.77 ± 2.99	-1.19 ± 3.87	.4178
Mean ± SD axial length (mm)	23.43 ± 1.13	23.60 ± 0.99	23.94 ± 1.43	.0864
Mean ± SD target refraction (D)[a]	-0.27 ± 0.12	-0.29 ± 0.16	-0.29 ± 0.16	.6980

D = diopters; IOL = intraocular lens; MRSE = manifest spherical equivalent value.
[a]The preoperative formula-predicted MRSE using that IOL power.

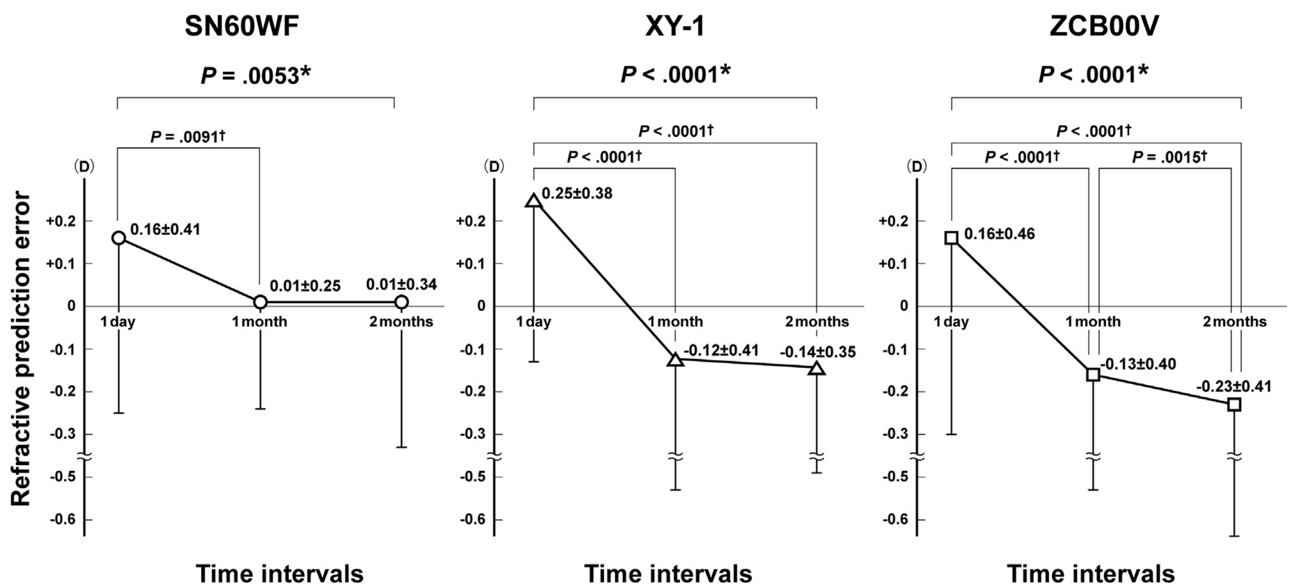

FIGURE 1. Longitudinal changes in the mean (±SD) refractive prediction error (PE) in eyes that received (left) the Alcon SN60WF (SN60WF group), (middle) Hoya XY-1 (XY-1 group), or (right) AMO ZCB00V (ZCB00V group) IOLs. Mean arithmetic PE significantly changed toward myopia among 1 day, 1 month, and 2 months postoperatively in all 3 IOL groups. In the SN60WF group (left), mean PE significantly changed between 1 day and 1 month postoperatively but did not change significantly between the other time interval pairs. In the XY-1 group (Middle), mean PE significantly changed between 1 day and 1 month and between 1 day and 2 months postoperatively but did not change significantly between 1 and 2 months postoperatively. In the ZCB00V group (right), mean PE significantly changed among all time-interval pairs. *Statistically significant differences among the 3 time intervals. †Statistically significant differences between each time interval pair.

• STATISTICAL ANALYSES: Data were tested for normality of distribution by inspection of histograms. Continuous variables that followed a normal distribution were compared using parametric tests, whereas the variables that did not follow a normal distribution were compared using nonparametric tests. Temporal changes in the continuous variables were compared using the repeated-measures analysis of variance (ANOVA) or Kruskal-Wallis test. When a significant difference was detected among the time intervals, the data between each time interval pair were compared using the paired *t* test or Mann-Whitney *U* test with a Bonferroni adjustment for multiple comparisons. Continuous variables were compared among the 3 groups using one-way ANOVA or the Kruskal-Wallis test. When a significant difference was detected among groups, the data between each group pair were compared using the unpaired *t* test or Mann-Whitney *U* test with a Bonferroni adjustment for multiple comparisons. Categorical variables were compared among groups using the chi-square goodness of fit test. To clarify the causes underlying the differences in the PE change among the 3 IOL groups, a general linear model analysis was performed. Six possible factors that might correlate with the PE changes during the first 2 postoperative months, including IOL type, change between 1 day and 2 months postoperatively in the anterior chamber depth, change in the Ave K value, change in the axial length, change in the central corneal thickness, and change in the central retinal thickness were entered into the analysis. Any differences with a *P* value less than .05 were considered statistically significant.

RESULTS

AMONG THE 195 PATIENTS, 3 PATIENTS (1.5%) WERE LOST TO follow-up; 2 patients were referred to other hospitals; and 1 patient refused examination. Accordingly, 192 eyes of 192 patients remained in the analysis (63 eyes in the SN60WF group, 65 eyes in the XY-1 group, and 64 eyes in the ZCB00V group). Because the surgical procedures and perioperative medications were essentially the same among the 3 IOL groups, the patients were unaware of the type of IOL implanted. In addition, because both eyes appeared to be similar, the examiners were unaware of the type of IOL implanted. Furthermore, because the assignment schedule was not revealed until all data were collected, the data analysts did not know the type of IOL implanted.

Patient demographics of the 3 IOL groups are provided in Table 1. The mean age ± standard deviation of the patients was 69.3 ± 5.8 years old, and there were 78 men and 114 women. The mean age, ratio of men to women, preoperative MRSE, preoperative corneal astigmatism, preoperative axial length, and preoperative anterior chamber depth did not differ significantly among the 3 IOL groups.

• **LONGITUDINAL CHANGE IN MRSE AND PE AND CHANGE IN PE:** Mean MRSE and arithmetic PE (Figure 1) significantly changed toward myopia among the 1-day, 1-month, and 2-month postoperative examinations in all 3 IOL groups ($P \leq .0053$). Comparison among each time-interval pair, in the SN60WF group, mean MRSE and PE significantly changed between 1 day and 1 month postoperatively ($P = .0091$) but did not change significantly between the other time-interval pairs. In the XY-1 group, mean MRSE and PE significantly changed between 1 day and 1 month and between 1 day and 2 months postoperatively ($P < .0001$) but did not change significantly between 1 and 2 months postoperatively. In the ZCB00V group, mean MRSE and PE significantly changed between all time-interval pairs ($P \leq .0015$). Absolute PE significantly changed during the first 2 postoperative months in the SN60WF and XY-1 groups ($P \leq .0207$), whereas it did not change significantly in the ZCB00V group. Comparisons between each time-interval pair, absolute PE significantly changed between 1 day and 1 month postoperatively in the SN60WF and XY-1 groups ($P \leq .0126$).

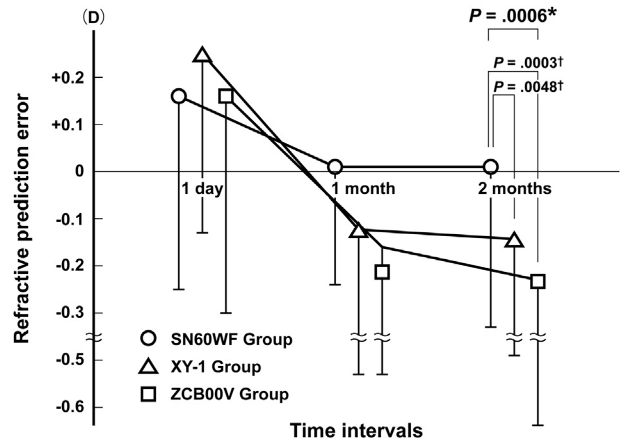

FIGURE 2. Comparison of the mean (±SD) refractive prediction error (PE) among eyes that received the Alcon SN60WF (SN60WF group), the Hoya XY-1 (XY-1 group), and the AMO ZCB00V (ZCB00V group) IOLs. Mean PE did not differ significantly among the 3 IOL groups at 1 day and 1 month postoperatively, and it was significantly smaller in the SN60WF group than in the XY-1 and ZCB00V groups at 2 months postoperatively. *Statistically significant difference among the 3 IOL groups, †Statistically significant difference between each IOL group pair.

• **COMPARISON OF MRSE AND PE AND CHANGES IN PE AMONG THE 3 IOL GROUPS:** Mean MRSE and PE (Figure 2) did not differ significantly among the 3 IOL groups at 1 day and 1 month postoperatively, but these were significantly smaller in the SN60WF group than in the XY-1 and ZCB00V groups at 2 months postoperatively ($P \leq .0006$). Absolute PE did not differ significantly at 1 day and 2 months postoperatively, but the value was significantly smaller in the SN60WF group than in the XY-1 and ZCB00V groups at 1 month postoperatively ($P = .0082$) (Figure 3). Mean changes in PE differed significantly among the 3 IOL groups between 1 day and 2 months postoperatively ($P = .0062$); the change was significantly smaller in the SN60WF group than in the XY-1 and ZCB00V groups (Figure 4).

The sample size of 192 eyes achieved 80.5% power to detect differences in PE at 2 months postoperatively among the means versus the alternative of equal means using the F test with a .0500 significance level. The size of the variation in the means was represented by their standard deviation which is 0.08. The common standard deviation within a group was assumed to be 0.36.

• **POSSIBLE FACTORS CORRELATING WITH PE CHANGES IN THE 3 IOL GROUPS:** The mean anterior chamber depth, Ave K, central corneal thickness, and central retinal thickness significantly changed during the postoperative 2 months in all 3 IOL groups ($P \leq .0431$), whereas the mean axial length did not change significantly (Table 2). In a comparison between each time-interval pair, mean anterior

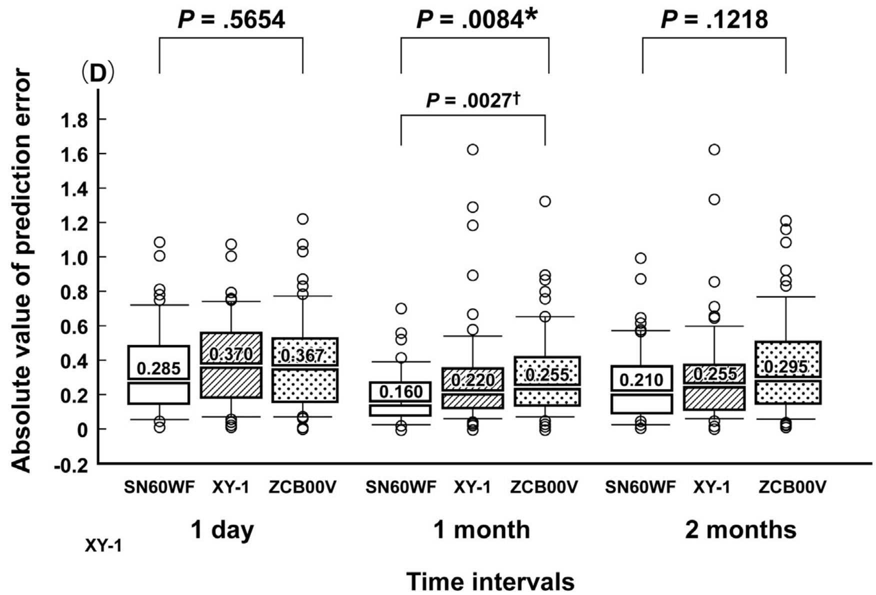

FIGURE 3. Comparison of the median (±95% quartile) absolute value of refractive prediction error (PE) among the eyes that received the Alcon SN60WF (SN60WF group), the Hoya XY-1 (XY-1 group), and the AMO ZCB00V (ZCB00V group) IOLs. Median absolute values of PE did not differ significantly at 1 day and 2 months postoperatively but were significantly smaller in the SN60WF group than in the XY-1 and ZCB00V groups at 1 months postoperatively. *Statistically significant difference among the 3 IOL groups, †Statistically significant difference between each IOL group pair.

chamber depth significantly decreased between 1 day and 1 month and between 1 day and 2 months postoperatively ($P < .0001$). Mean Ave K values significantly increased between 1 day and 2 months in the SN60WF and XY-1 groups ($P = .0018$). Mean central corneal thickness significantly decreased between all time-interval pairs ($P \leq .0092$). Mean central retinal thickness significantly increased between 1 day and 2 months postoperatively ($P \leq .0010$).

Mean anterior chamber depth differed significantly among the 3 IOL groups at all time intervals ($P < .0001$), whereas mean Ave K, axial length, central corneal thickness, and central retinal thickness did not differ significantly among the 3 IOL groups (Table 2). Mean changes in the anterior chamber depth differed significantly among the groups between 1 day and 1 month and between 1 day and 2 months postoperatively ($P < .0001$) with no significant changes detected between 1 month and 2 months. The change was significantly greater in the XY-1 group than in the SN60WF and ZCB00V groups ($P \leq .0151$). The mean change in Ave K was also significantly different among the 3 groups between 1 and 2 months postoperatively ($P = .0165$).

• **GENERAL LINEAR MODEL ANALYSIS TO CLARIFY FACTORS CORRELATING WITH PE CHANGES DURING THE 2 POSTOPERATIVE MONTHS:** To clarify the mechanism underlying the differences in the PE change during the first 2 postoperative months differ among the 3 IOL groups, a general linear model analysis was performed. When entering the 6 possible factors in the model, IOL type, change in anterior chamber depth, and change in Ave K were significantly correlated with the PE changes, whereas changes in axial length, central corneal thickness, or central retinal thickness were not significantly correlated. After adjusting for the changes in the anterior chamber depth, Ave K, axial length, central corneal thickness, and central retinal thickness, the IOL type was still significantly correlated with the PE changes. The SN60WF IOL group was associated with a significantly smaller change in the PE compared with the XY-1 and ZCB00V groups ($P \leq .0161$).

DISCUSSION

THE FINDINGS OF THE PRESENT STUDY REVEALED THAT THE MRSE and arithmetic PE showed a significant myopic shift during the first 2 postoperative months in eyes implanted with 3 types of single-piece acrylic IOLs. Specifically, the MRSE and PE changed significantly between 1 day and 1 month after surgery in eyes implanted with the SN60WF and XY-1 IOLs, whereas those changed significantly between 1 day and 1 month and between 1 and 2 months in eyes implanted with the ZCB00V IOLs. Furthermore, MRSE and PE differed significantly among the 3 IOL types at 2 months after surgery. MRSE and PE were significantly smaller in the SN60WF group than in the XY-1 and ZCB00V groups. In addition, the changes in the PE during the 2 first postoperative months was significantly smaller in the SN60WF group than in the XY-1 and ZCB00V groups.

These findings suggest that postoperative refractive stability differed even among single-piece acrylic IOL types.

To clarify the factors affecting the PE changes, 6 possible factors were evaluated, including IOL type, changes in the anterior chamber depth, Ave K values, axial length, and central corneal and retinal thickness. Of those factors, the anterior chamber depth, Ave K value, and central corneal and retinal thickness significantly changed over 2 months. Additionally, the change in the anterior chamber depth and Ave K differed significantly among the 3 groups. When the 6 factors were entered in the general linear model, the IOL type and change in the anterior chamber depth and Ave K significantly correlated with the PE change. Furthermore, after adjustments were made for the other 5 factors in this model, IOL type was still significantly correlated. These findings suggest that the PE changes cannot be accounted for by a change in the anterior chamber depth and corneal curvature. The IOL type itself should not affect the PE changes, suggesting that unknown factors of single-piece acrylic IOLs, including the properties of the haptic and optic material and design, or interactions with the lens capsule, affect refractive stability.

Postoperative refraction changed toward myopia in the immediate or early periods after cataract surgery.[9-14] Specifically, previous studies showed that eyes implanted with a multipiece acrylic IOL exhibited a significant myopic change, whereas eyes with single-piece acrylic IOL did not reveal a significant change.[9-13] Additionally, the postoperative myopic change with multipiece acrylic IOLs was attributed to an anterior shift of the IOL and a change in the corneal curvature.[9-19] No studies to date, however, have compared changes in the postoperative refraction and PE among eyes with single-piece acrylic IOLs, despite the current popularity of this type of IOL and the substantial number of single-piece acrylic IOL types available. The present study revealed that MRSE and PE significantly change toward myopia during the first 2 postoperative months and that the change in MRSE and PE differed significantly even among single-piece acrylic IOL types. Furthermore, the changes in the anterior chamber depth and Ave K correlated significantly with the PE changes, but other unknown factors may also affect the PE change associated with single-piece acrylic IOLs.

This study has several limitations. First, long-term changes in refraction and PE were not examined. Mean MRSE and PE changed significantly between 1 and 2 months after surgery in the ZCB00V group but not in the SN60WF and XY-1 groups, suggesting that the refraction may not stabilize until 2 months after surgery for 1 of

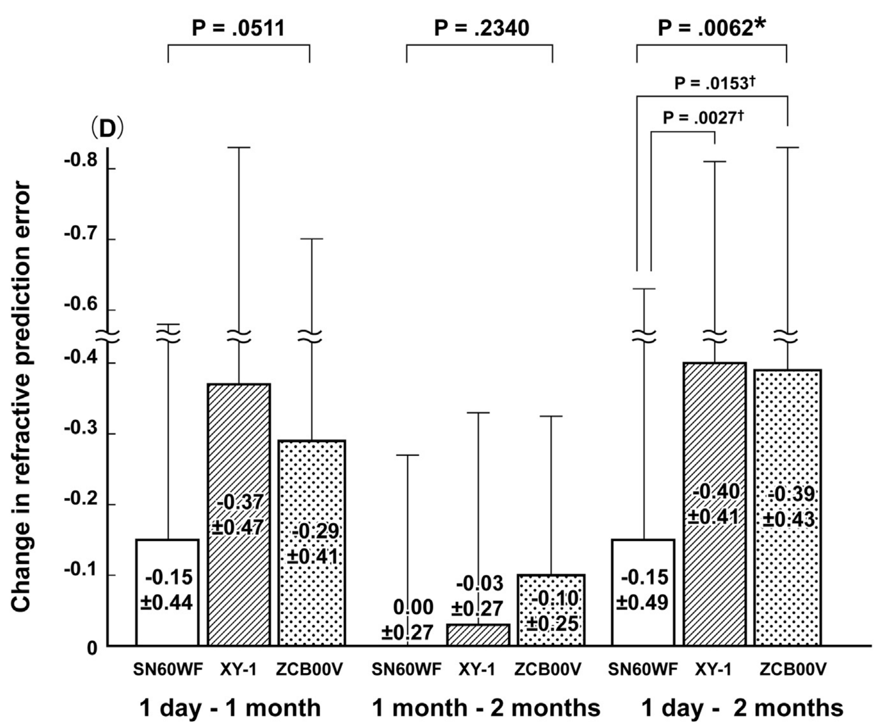

FIGURE 4. Comparison of the mean (±standard deviation) change in the refractive prediction error (PE) during the first 2 postoperative months among eyes that received the Alcon SN60WF (SN60WF group), the Hoya XY-1 (XY-1 group), and the AMO ZCB00V (ZCB00V group) IOLs. Mean changes in PE differed significantly among the 3 IOL groups between 1 day and 2 months postoperatively; these changes were significantly smaller in the SN60WF group than in the XY-1 and ZCB00V groups. *Statistically significant difference among the 3 IOL groups, †Statistically significant difference between each IOL group pair.

TABLE 2. Comparison of Mean (±SD) Anterior Chamber Depth, Average Corneal Curvature, Axial Length, Central Corneal Thickness, Central Retinal Thickness Postoperatively, and Change in These Endpoints During the 2 Postoperative Months among Eyes that Received the Alcon Sn60WF (Sn60WF Group), the HOYA XY-1 (XY-1 Group), and the AMO ZCB00V (ZCB00V Group) and Among the 3 time Intervals and Time Interval Pairs

Parameters	Sn60WF Group (n = 63)	XY-1 Group (n = 65)	ZCB00V Group (n = 64)	*P* Value[b]
Anterior chamber depth (mm)				
1 day postop	4.22 ± 0.34	4.35 ± 0.34	4.55 ± 0.28	< .0001[a]
1 month postop	4.07 ± 0.33	4.08 ± 0.28	4.36 ± 0.27	< .0001[a]
2 months postop	4.10 ± 0.26	4.08 ± 0.28	4.38 ± 0.27	< .0001[a]
P value[c]	< .0001[a]	< .0001[a]	< .0001[a]	
Average corneal curvature (D)				
1 day postop	43.23 ± 1.30	43.09 ± 1.30	43.08 ± 1.61	.7515
1 month postop	43.33 ± 1.28	43.11 ± 1.24	43.25 ± 1.59	.4770
2 months postop	43.39 ± 1.25	43.19 ± 1.29	43.25 ± 1.59	.5712
P value[c]	.0016[a]	.0432[a]	.0258[a]	
Axial length (mm)				
1 day postop	23.40 ± 1.13	23.56 ± 0.99	23.89 ± 1.43	.1008
2 months postop	23.38 ± 1.12	23.54 ± 1.02	23.86 ± 1.43	.1165
P value[c]	.3155	.3927	.8976	
Central corneal thickness (μ)				
1 day postop	557.75 ± 40.82	561.66 ± 41.86	555.38 ± 57.45	.8969
1 month postop	538.76 ± 32.48	543.25 ± 36.29	540.38 ± 36.14	.6418
2 months postop	532.81 ± 32.12	539.75 ± 29.63	535.03 ± 35.17	.3380
P value[c]	< .0001[a]	< .0001[a]	< .0001[a]	
Central retinal thickness (μ)				
1 day postop	246.87 ± 26.87	247.99 ± 28.56	249.33 ± 27.08	.9543
2 months postop	258.87 ± 24.67	261.69 ± 33.13	270.44 ± 55.32	.5323
P value[c]	< .0001[a]	< .0001[a]	.0010[a]	
Change in anterior chamber depth (mm)				
1 day - 1 month	-0.16 ± 0.29	-0.27 ± 0.28	-0.20 ± 0.12	< .0001[a]
1 month - 2 months	0.04 ± 0.20	0.00 ± 0.10	0.02 ± 0.07	.3311
1 day - 2 months	-0.12 ± 0.22	-0.27 ± 0.29	-0.17 ± 0.11	< .0001[a]
Change in average corneal curvature (D)				
1 day - 1 month	0.10 ± 0.41	0.03 ± 0.38	0.07 ± 0.56	.5862
1 month - 2 months	0.06 ± 0.21	0.08 ± 0.30	0.10 ± 0.52	.0165[a]
1 day - 2 months	0.16 ± 0.39	0.11 ± 0.35	0.17 ± 0.42	.5771
Change in axial length (mm)				
1 day - 2 months	-0.02 ± 0.18	-0.02 ± 0.15	-0.03 ± 0.06	.7567
Change in central corneal thickness (μ)				
1 day - 2 months	-18.98 ± 25.99	-18.42 ± 21.91	-15.00 ± 44.23	.5148
1 month - 2 months	-5.95 ± 9.91	-3.49 ± 19.49	-5.34 ± 11.57	.9668
1 day - 2 months	-24.94 ± 26.19	-21.91 ± 22.18	-20.34 ± 44.23	.4174
Change in central retinal thickness (μ)				
1 day - 2 months	11.94 ± 18.51	13.71 ± 13.10	21.11 ± 48.72	.1249

D = diopters; postop = postoperative.
[a]Statistically significant differences.
[b]*P* value among the 3 time intervals or between time interval pairs.
[c]*P* value among the 3 IOL groups.

the 3 IOL types. Because the purpose of this study was to compare the short-term PE changes among eyes receiving 1 of 3 types of single-piece acrylic IOLs, however, the authors wished to examine the time periods of refractive stabilization in each IOL type in the next study. Second, objective refraction was analyzed using an autorefractometer. Subjective refraction is a standard method of measuring refractive states but is potentially confounded by patient and examiner bias. Although objective refraction is currently measured using a standard autorefractometer or an aberrometer system, the accuracy and reproducibility of standard autorefraction are comparable to those measured by aberrometer-based autorefraction.[25-30] Considering this information together, the results and conclusions obtained in the present study are correct.

In conclusion, postoperative refraction and PE significantly changed toward myopia (−0.31 D, on average) in eyes implanted with 1 of 3 types of single-piece acrylic IOLs during the first 2 postoperative months, and the MRSE and PE were significantly smaller with the SN60WF IOL than with the other IOLs. Changes in PE were also significantly different among the single-piece acrylic IOLs, and the PE change was independently correlated with the IOL type, and the changes in the anterior chamber depth and corneal curvature. These findings suggest that unknown factors affecting the PE changes may exist in the single-piece acrylic IOLs. Because postoperative refractive stability is clinically important when selecting the IOL type, further studies are necessary to identify the unknown factors that affect the PE change after cataract surgery.

ALL AUTHORS HAVE COMPLETED AND SUBMITTED THE ICMJE FORM FOR DISCLOSURE OF POTENTIAL CONFLICTS OF INTEREST and none were reported.

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