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ARTICLE

Comparison of visual function and patient-reported outcomes between two full range of field intraocular lenses: a randomized controlled study

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Purpose: To compare visual and patient-reported outcomes in patients with cataracts bilaterally implanted with PanOptix or Synergy intraocular lenses (IOLs).

Settings: 5 sites in the United States.

Design: Prospective, parallel-arm randomized patient-masked and examiner-masked clinical study.

Methods: Adult patients with cataract (≥22 years) were randomized (1:1) to receive bilateral PanOptix or Synergy IOL implantation. Study endpoints: binocular uncorrected (UDVA) and corrected distance visual acuity (CDVA) (logMAR) at distance, intermediate (60 cm), and near (40 and 33 cm); defocus curve; patient-reported visual disturbances, spectacle independence, and visual satisfaction using questionnaires at 6 months; and binocular contrast sensitivity at 3 months.

Results: At 6 months, PanOptix (n = 138) was noninferior to Synergy (n = 138) IOLs for photopic binocular UDVA and CDVA at all tested distances ($P < .05$). Mesopic intermediate and near VA showed a similar trend. Defocus curves showed that both IOLs provided VA of ≤0.1 logMAR from −2.50 to +0.50 diopters (D) and <0.2 logMAR at −3.00 D. A significantly lower proportion of patients with PanOptix (vs Synergy) experienced starbursts and glare ($P < .05$). Most patients in both groups reported never/rarely needing spectacles to see and high satisfaction with vision. Both IOLs provided similar binocular contrast sensitivity at 3 months under photopic and mesopic conditions.

Conclusions: PanOptix IOLs provided a similar full range of vision, spectacle independence, and contrast sensitivity, but superior tolerance to glare and starbursts, compared with Synergy IOLs.

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Presbyopia is an age-related visual impairment that occurs because of loss of accommodation. It is associated with features of blurred vision and an inability to see with clarity at a near working distance.[1] Presbyopia is estimated to affect 1.09 billion people globally, with varying prevalence across regions and groups.[1,2] In the United States, the prevalence of presbyopia ranged from 83.0% to 88.9% among adults aged 45 years or older.[3,4] Uncorrected or undercorrected presbyopia affects vision-related quality of life and the ability to perform daily activities.[1,5] Presbyopia is common in older patients presenting for cataract surgery.[1] Furthermore, cataract is a common cause of visual impairment in the elderly and can be treated through surgery.[6]

The current standard of care for patients with cataract is cataract removal with monofocal intraocular lens (IOL) implantation; however, spectacle dependence for near and intermediate vision is high.[7–9] Multifocal IOLs provide good vision over a range of distances and reduce spectacle dependence compared with monofocal IOLs; however, they may cause visual disturbances such as halos and glares.[10–12] Trifocal IOLs have demonstrated better intermediate vision than bifocal IOLs, without compromising distance and near vision.[13,14] Furthermore, extended-depth-of-focus (EDOF) IOLs provide good intermediate and functional near vision, but near vision is generally not as good as that of multifocal IOLs.[15]

AcrySof PanOptix (TFNT00, Alcon Laboratories, Inc.) is a trifocal IOL with a proprietary diffractive optical design and enhanced light energy (ENLIGHTEN) technology, to provide focal points at distance, intermediate (60 cm), and

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near (40 cm), with high-energy utilization.[16] Owing to its intermediate focal point at 60 cm (relaxed arms' length), this 1-piece lens is considered to provide a higher comfort for intermediate tasks than traditional trifocal IOLs.[16]

The TECNIS Synergy IOL (ZFR00V, Johnson & Johnson Vision) combines the diffractive EDOF and bifocal optical designs to provide a range of vision from distance to intermediate to near at 33 cm.[17,18] It corrects chromatic aberration and includes violet light filtering chromophores, to improve image contrast in both photopic and mesopic conditions and reduce visual phenomena.[18]

To date, few studies have compared trifocal IOLs (PanOptix) with EDOF/bifocal IOLs (Synergy) in patients with cataracts.[19–23] To add to the existing evidence, this prospective, multicenter, randomized, comparative study was conducted to assess and compare visual function and patient-reported outcomes of visual disturbances, spectacle dependence, and overall satisfaction in patients with cataracts who were bilaterally implanted with PanOptix or Synergy IOLs.

METHODS

Study Design

This was a prospective, multicenter, randomized, patient-masked and examiner-masked, controlled, bilateral clinical trial conducted between November 1, 2021, and November 29, 2023, across 5 sites in the United States. The study was approved by an Institutional Review Board (IRB)/Independent Ethics Committee at each study center and was conducted in accordance with IRB regulations and Good Clinical Practice; International Council for Harmonization guidelines; tenets of the Declaration of Helsinki; Health Insurance Portability and Accountability Act guidelines; and applicable local, state, and federal requirements. Written informed consent was obtained from all patients before study commencement. The study was registered at www.clinicaltrials.gov (NCT05186298).

Study Population

Patients included were adults (aged ≥22 years) with bilateral cataracts with otherwise clear intraocular media. All patients had a projected uncorrected distance VA (UDVA) of ≤0.10 logarithm of the minimum angle of resolution (logMAR) and preoperative regular corneal astigmatism of ≤0.75 diopters (D), in both eyes.

Exclusion criteria included patients with clinically significant corneal abnormality, inflammation, degeneration, or conditions affecting postoperative VA; glaucoma, ocular hypertension; amblyopia, strabismus; prior corneal refractive surgery; and retinal detachment. Patients with previous anterior or posterior segment surgery, diabetic retinopathy, and macular degeneration were also excluded at the investigator's discretion.

Study Procedures

Patient demographic data, medical history, and ophthalmic evaluations (for both eyes) were collected to assess eligibility 30 days before surgery. Eligible patients underwent bilateral cataract surgery with implantation of either AcrySof IQ PanOptix (TFNT00) or Tecnis Synergy (ZFR00V) IOL. The randomization was 1:1; envelopes containing cards with each IOL were created and then shuffled for randomization, after which each envelope was numbered sequentially (one onward). A patient enrolled was given the next available number. Femtosecond laser-assisted phacoemulsification cataract removal was followed by intraoperative aberrometry to confirm the power of the chosen implant based on the Barrett Universal II IOL formula. The constant of 119.3 was used for Synergy IOL and 119.1 was used for PanOptix IOL. Emmetropia was targeted in both eyes. Patients visited the sites for study evaluations postoperatively at 1 month (3 to 5 weeks), 3 months (±2 weeks), and 6 months (±2 weeks) after the second-eye surgery.

Study Endpoints

Postoperative 6-month data are reported for binocular uncorrected and corrected distance VA (logMAR) at distance (4 m; UDVA, CDVA), intermediate (60 cm; UIVA, DCIVA), and near (40 cm and 33 cm; UNVA, DCNVA) in photopic conditions; DCIVA and DCNVA (40 cm and 33 cm) in mesopic conditions; manifest refraction; defocus curves; and patient-reported visual disturbances, visual satisfaction, and spectacle independence. Binocular contrast sensitivity was evaluated at 3 months postoperatively. Adverse events were also recorded.

Study Assessments

Visual acuities (at near/intermediate/distance) were measured using printed Early Treatment Diabetic Retinopathy Study (ETDRS) charts (Precision Vision) under photopic (85 cd/m^2) or mesopic (3 cd/m^2) conditions. For intermediate and near charts, a connected cord was used that ensured the desired distance. A light meter (Mavolux from Gossen) was used to ensure the chart luminance was at 85 cd/m^2; it was then dimmed to mesopic condition of 3 cd/m^2 with the neutral density filter. The room light was always dimmed to be lower than the chart light. For mesopic measurements, patients were dark-adapted for at least 10 minutes. Manifest refraction was performed with a high-contrast logMAR chart at 4 m under photopic conditions.

For evaluation of the binocular defocus curve, patients were fitted with their distance refraction, and VA (logMAR) was measured between +1.00 D and −3.00 D in 0.50 D defocus steps, except between 0.00 D and ±0.50 D which was measured in 0.25 D steps. Different 4 m ETDRS charts were alternated for different defocus curves to avoid memorization of letters.

Patient-reported visual disturbances (e.g., halos, starbursts, and glare) were evaluated using the validated questionnaire for visual disturbances (QUVID). The responses were recorded on a 5-point scale from "never" to "always" for frequency, from "none" to "severe" for severity of the patient's worst experience, and from "not bothered at all" to "bothered very much" for bothersomeness with the specific visual disturbance. Patient-reported visual satisfaction was evaluated as patient's satisfaction with IOLs, quality of vision without spectacles (bright/dim light), and spectacle independence using the validated IOL satisfaction (IOLSAT) questionnaire.[8]

Contrast sensitivity testing was conducted binocularly using the CSV-1000 (Vector Vision, Inc.) under photopic (85 cd/m^2) and mesopic (3 cd/m^2) conditions; performed at 2.5 m with best spectacle correction in place for each of 4 spatial frequencies (photopic: 3, 6, 12, and 18 cycles per degree [cpd]; mesopic: 1.5, 3, 6, and 12 cpd using a neutral density filter, to reduce the effective chart luminance to approximately 3 cd/m^2). For the patch identification, patients were given 3 choices: top, bottom, or blank (cannot see either top or bottom stripes). The last correct response at each spatial frequency was recorded as the contrast sensitivity. Before mesopic contrast sensitivity testing, participants were adapted in the dark for 10 minutes in an examination room with the lights turned off. The illuminated contrast sensitivity chart was viewed through neutral density filters placed in a plastic frame. This reduced the effective chart luminance to approximately 3 cd/m^2.

Sample Size

Assuming a power of 80%, alpha of 0.05, 1-sided noninferiority (NI) margin at 0.1 logMAR, mean differences of DCNVA (40 cm) between 2 groups of 0.05 logMAR, and the SD as 0.15 logMAR, a sample size of 112 per group was required. Furthermore, accounting for a 10% dropout rate, the minimum sample needed was

250 for bilateral implantation of the study IOLs in a 1:1 randomization ratio.

For the patient-reported visual disturbance outcomes, at least 120 patients per group were needed for superiority statistical significance (alpha of 0.05 and power of 80%) by using the estimate of a "not bothered by dysphotopsia" rate of 80% in PanOptix and 64% in Synergy groups based on published data.[21,24,25]

Statistical Analysis

Statistical analyses were performed using R-4.3.1. Descriptive statistics were used for summarizing demographic and baseline characteristics data by treatment group (PanOptix and Synergy). Mean, SD, median, minimum, and maximum were reported for continuous variables, and frequency and proportion were reported for categorical variables. The "step-down" statistical analysis approach was used for multiple noninferiority tests for visual acuities (binocular DCNVA [40 cm], followed by CDVA, DCIVA, and DCNVA [33 cm], and then the uncorrected VAs).

According to the null hypothesis (H0), the mean difference between the PanOptix and Synergy IOLs at a specified VA was ≥0.1 logMAR, indicating that the PanOptix IOL was inferior to the Synergy IOL; H0: $\mu(S) - \mu(P) \geq 0.1$. The alternate hypothesis (H1) was that the mean difference between the PanOptix and Synergy IOLs at a specified VA was <0.1 logMAR, indicating that the PanOptix IOL was noninferior to the Synergy IOL, with a predefined margin of 0.1 logMAR; H1: $\mu(S) - \mu(P) < 0.1$. A P value less than 0.05 indicated that the mean difference between groups was <0.1 logMAR, thus supporting the noninferiority of PanOptix to the Synergy IOL. The noninferiority comparison between the IOL groups for binocular readings was conducted using the 1-sided 95% CI, NI margin of 0.1 logMAR, and an alpha level of 0.05 based on the mean difference of the variables. Two-sample t tests were used for analyses, and $P \leq .05$ was considered statistically significant. The Friedmann test was used to compare the binocular defocus curves; the chi-square test or Fisher exact test was used to compare patient-reported visual disturbances, spectacle independence, and satisfaction using the validated QUVID and IOLSAT questionnaires between PanOptix and Synergy groups. The standards for measuring and reporting outcomes of IOL-based surgery and the recommendations for writing manuscripts on IOLs have been followed.[26,27]

RESULTS

Patient Disposition and Demographics

Overall, 292 patients were enrolled. Of these, 144 and 148 eligible patients were successfully implanted bilaterally with PanOptix and Synergy IOLs, respectively. Patient demographics and baseline characteristics from the 2 groups were similar (Table 1).

Binocular Visual and Refractive Outcomes

PanOptix was noninferior to Synergy IOL for photopic CDVA (4 m), DCIVA (60 cm), and DCNVA (40 cm and 33 cm) (logMAR); and photopic UDVA (4 m), UIVA (60 cm), and UNVA (40 cm and 33 cm) (logMAR), at 6 months postoperatively (NI margin of 0.1 logMAR; $P < .05$; Table 2). The maximum difference between 2 groups at any measured distance was 1.5 letters (~0.03 logMAR). Similarly, PanOptix was noninferior to Synergy IOL for mesopic binocular DCIVA (60 cm) and DCNVA (40 cm and 33 cm) at 6 months ($P < .05$; Table 2).

At 6 months, the mean manifest refraction spherical equivalent was 0.02 ± 0.30 and 0.16 ± 0.38 in the PanOptix and Synergy groups, respectively ($P < .0001$) (Table 2). Descriptive data of refractive outcomes are shown in Figure 1. The proportion of patients who achieved $20/20^{-2}$, $20/25^{-2}$, and $20/32^{-2}$ or better were numerically similar or higher (difference of 1.0% to 13.0%) for PanOptix vs Synergy for UDVA and CDVA (Figure 1A). Similarly, some numerical differences were observed for the proportion of patients who achieved $20/20^{-2}$, $20/25^{-2}$, and $20/32^{-2}$ or better for intermediate and near VA between PanOptix and Synergy IOLs (Figure 1B–D).

Defocus Curve

Figure 2 shows the binocular defocus curve from +1.00 D to −3.00 D of patients implanted with either PanOptix or Synergy IOLs. There was no statistically significant difference between the 2 groups at all defocus levels ($P > .05$) (Figure 2). Both IOLs provided a mean VA of ≤0.1 logMAR (20/25 Snellen) from distance to near at 40 cm and ≤0.2 logMAR (20/32 Snellen) from distance to near at 33 cm.

Patient-Reported Visual Disturbances

A significantly lower proportion of patients from the PanOptix vs Synergy group reported "yes" for experiencing starbursts (53.5% vs 74.6%) and glare (39.8% vs 57.8%) at 6 months ($P < .05$, Figure 3A). However, no significant difference was observed between the IOLs for halos (PanOptix vs Synergy: 54.0% vs 64.8%; $P > .05$, Figure 3A). A significantly lower percentage of patients from the PanOptix group (vs Synergy) reported experiencing "moderate" to "severe" starbursts and glare (39.7% vs 68.8% and 19.7% vs 33.6%; $P < .05$, Figure 3B). However, no significant difference was observed between the IOLs for halos (PanOptix vs Synergy: 38.2% vs 48.0%; $P > .05$, Figure 3B). Furthermore, patients who reported "not experienced" plus "experienced but not bothered at all—bothered a little bit" by starbursts were significantly higher in the PanOptix vs Synergy group (71.4% vs 50.8%; $P < .05$, Figure 3C, Supplementary Table 1, available at http://links.lww.com/JRS/B347). Consistently, a significantly lower proportion of patients from the PanOptix (vs Synergy) group reported "bothered quite a bit—bothered very much" by starbursts (14.3% vs 23.4%; $P < .05$). However, no significant differences were observed between the IOLs for halos and glare (PanOptix vs Synergy: $P > .05$ for both, Figure 3C).

Patient-Reported Satisfaction and Spectacle Independence

Most patients with both IOLs (PanOptix and Synergy) reported high satisfaction with vision (83.1% and 82.0%) at 6 months postoperatively (Figure 4A). A similar proportion of patients with both PanOptix (90.8%) and Synergy (89.7%) reported "never" or "rarely" needing spectacles to see in the past 7 days (Figure 4B).

At 6 months, a high proportion of patients with PanOptix and Synergy IOLs reported good/very good quality of vision under bright light, when not using spectacles to see at arm's length (PanOptix: 94.4%; Synergy: 90.9%), far away (PanOptix: 89.8%, Synergy: 77.8%), and up close (PanOptix: 87.0%; Synergy: 89.9%) (Supplementary Figure 1, available at http://links.lww.com/JRS/B345). Most patients

Table 1. Patient demographic and baseline characteristics

Characteristics	PanOptix (n = 144)	Synergy (n = 148)	*P* value
Age (y)[a]	67.73 ± 7.06	67.84 ± 7.61	.89
Sex			
F	83 (57.6)	88 (59.5)	.84
M	61 (42.4)	60 (40.5)	
VA			
Monocular UDVA[b]	0.65 ± 0.37	0.61 ± 0.37	.12
Monocular CDVA	0.20 ± 0.20	0.21 ± 0.22	.75
Binocular UDVA	0.53 ± 0.36	0.49 ± 0.35	.26
Binocular CDVA	0.14 ± 0.16	0.15 ± 0.17	.80
Manifest refraction			
Sphere	−0.59 ± 2.82	−0.53 ± 2.79	.69
Cylinder	0.74 ± 0.51	0.74 ± 0.53	>.99
MRSE	−0.22 ± 2.79	−0.16 ± 2.74	.62

MRSE = manifest refraction spherical equivalent
[a]One missing value was observed in PanOptix and Synergy for the variable age
[b]One missing value was observed for monocular UDVA in Synergy

from the PanOptix group (90.5% and 88.0%) and the Synergy group (83.9% and 85.6%) reported that they would choose the same lens again and would recommend the implanted lenses to family or friends.

Contrast Sensitivity

Overall, binocular photopic and mesopic contrast sensitivity outcomes were similar among the 2 groups at all measured spatial frequencies (Supplementary Figure 2, available at http://links.lww.com/JRS/B346).

Safety Outcomes

At 6 months, chalazion was reported for 1 patient in the Synergy group. In the PanOptix group, 1 patient each described a slight decrease in vision, eyes not coordinating well, and increased need for light when reading small print; in the Synergy group, 1 patient reported considerable difficulty seeing at night with bothersome glare, at 6 months (Supplementary Table 2, available at http://links.lww.com/JRS/B347). No explants were reported in the study.

DISCUSSION

This prospective randomized clinical study compared visual function and patient-reported outcomes between the diffractive trifocal PanOptix IOL and diffractive hybrid EDOF and bifocal Synergy IOL. The visual outcomes analysis showed that PanOptix was noninferior to Synergy IOLs for photopic binocular VAs at all tested distances including near (40 cm and 33 cm) at 6 months postoperatively, with no clinically relevant difference observed between the 2 IOLs (maximum difference between the IOLs at any distance was 1.5 letters).[28] PanOptix also provided

Table 2. Mean binocular UDVA and CDVA and manifest refraction at 6 months

VAs	PanOptix (n = 138)	Synergy (n = 138)	95% CI	*P* value
Photopic condition				
UDVA 4 m	0.02 ± 0.11	0.05 ± 0.09	−Inf, 0	<.0001
UIVA 60 cm	0.09 ± 0.14	0.09 ± 0.12	−Inf, 0.02	<.0001
UNVA 40 cm	0.15 ± 0.15	0.14 ± 0.11	−Inf, 0.02	<.0001
UNVA 33 cm	0.22 ± 0.13	0.23 ± 0.11	−Inf, 0.02	<.0001
CDVA 4 m[a]	−0.02 ± 0.08	−0.01 ± 0.09	−Inf, 0	<.0001
DCIVA 60 cm[a]	0.12 ± 0.14	0.12 ± 0.14	−Inf, 0.02	<.0001
DCNVA 40 cm[a]	0.13 ± 0.12	0.13 ± 0.12	−Inf, 0.02	<.0001
DCNVA 33 cm[a]	0.21 ± 0.13	0.19 ± 0.12	−Inf, 0.04	<.0001
Mesopic condition				
DCIVA 60 cm	0.29 ± 0.23	0.33 ± 0.24	−Inf, 0	<.0001
DCNVA 40 cm	0.32 ± 0.23	0.35 ± 0.25	−Inf, 0.02	<.0001
DCNVA 33 cm	0.40 ± 0.24	0.41 ± 0.25	−Inf, 0.04	<.0001
Manifest refraction	**PanOptix (n = 276 eyes)**	**Synergy (n = 276 eyes)**	**95% CI**	***P* value**
Sphere	−0.02 ± 0.29	0.10 ± 0.40	−0.25, 0	<.0001
Cylinder[b]	0.08 ± 0.36	0.11 ± 0.34	0, 0	.12
MRSE	0.02 ± 0.30	0.16 ± 0.38	−0.25, −0.12	<.0001

MRSE = manifest refraction spherical equivalent; NI = noninferiority
NI was tested using NI margin of 0.1 logMAR
[a]One missing value each was observed in CDVA 4 m, DCIVA 60 cm, DCNVA 40 cm, and DCNVA 33 cm in both groups for photopic conditions
[b]One missing value was observed for the cylinder in the Synergy group

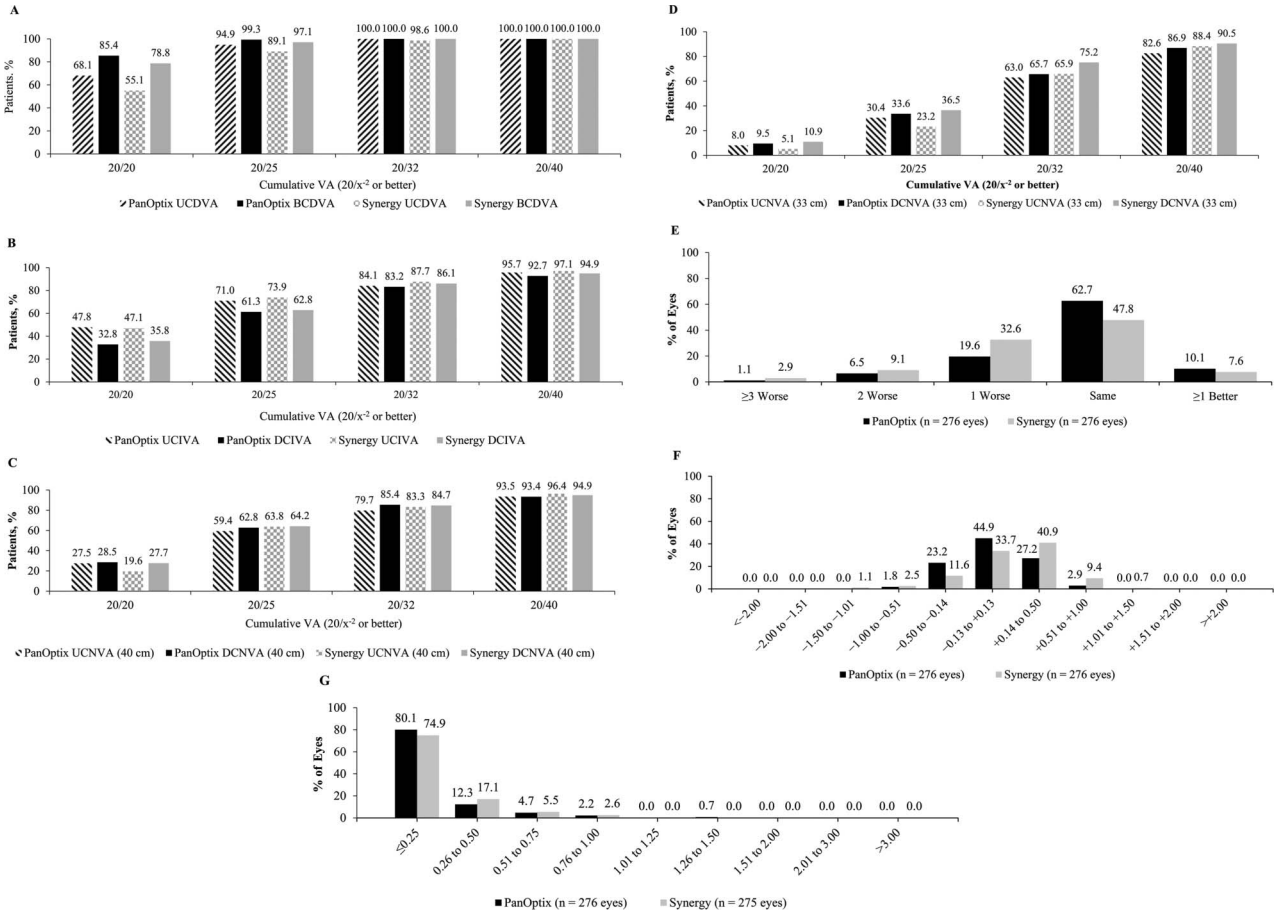


Figure 1. Cumulative percentage of patients achieving corrected and uncorrected VA at *A*: distance; *B*: intermediate; and *C*, *D*: near (40 cm and 33 cm) at 6 months. Refractive outcomes at 6 months—*E*: difference between postoperative UDVA and CDVA (in Snellen lines), *F*: distribution of postoperative manifest refraction spherical equivalent, and *G*: distribution of postoperative refractive cylinder. One missing value was observed for the cylinder in the Synergy group.

similar VAs at intermediate (60 cm) and near under mesopic conditions. The comparable VA results were supported by defocus curve outcomes, with no significant difference observed between PanOptix and Synergy on VA at defocus values from +1.00 D to −3.00 D at 6 months ($P > .05$). A significantly lower proportion of patients with PanOptix IOLs experienced visual disturbances (starbursts and glare) than Synergy IOLs at 6 months ($P < .05$). Most patients from both groups were spectacle-independent and reported similar overall satisfaction with their vision at 6 months. Monocular corrected and uncorrected VAs were measured, and the noninferiority results were similar to that observed for the binocular VAs. These monocular data have not been included in the study because we focused on reporting patients' binocular vision and associated spectacle usage and visual disturbances.

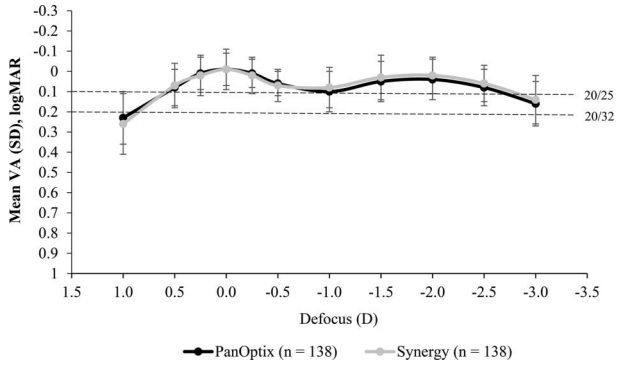


Figure 2. Binocular defocus curves at 6 months. Error bars indicate standard deviation.

Modern patients with cataract often desire high spectacle independence.[29] PanOptix and Synergy IOLs are designed to provide a full range of vision, from distance to near.[30,31] Consistent with previous reports, our study showed that both IOLs provided comparable binocular distance and intermediate VA.[19–22] Furthermore, our findings showed that PanOptix IOLs demonstrated comparable binocular photopic and mesopic UNVA and DCNVA (40 cm and 33 cm) with Synergy IOLs at 6 months, which is consistent with the findings from the Ferreira study that reported no difference between the IOLs in photopic UNVA and DCNVA at 40 cm (at 3 months).[21]

However, Dick et al. reported statistically significant differences between PanOptix and Synergy in CDVA (up to 2.5 letters) and DCNVA at 40 and 33 cm (up to 4 letters) at

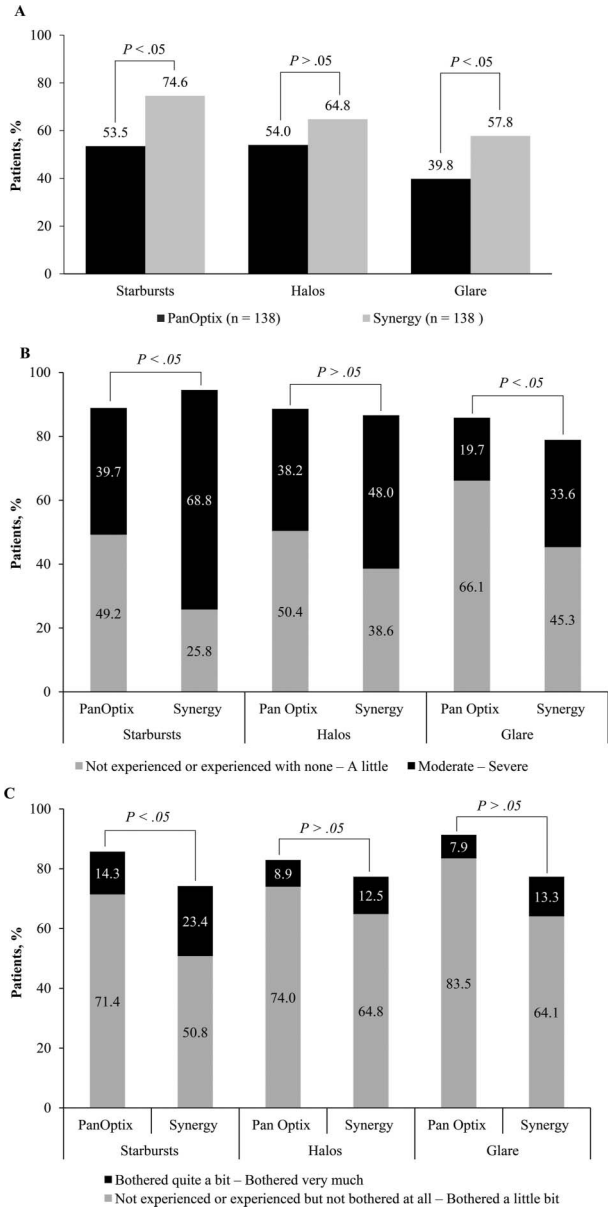


Figure 3. Patients experiencing visual disturbances at 6 months evaluated through QUVID. *A*: Patients who reported "yes" to the question if experiencing starbursts, halos, or glare in the past 7 days. *B*: Patient-reported level of severity to the question "how severe your worst experience was with starbursts, halos, or glare in the past 7 days." *C*: Patient-reported level of bothersomeness to the question "how much have your starbursts, halos, or glare bothered you in the past 7 days." QUVID = questionnaire for visual disturbances

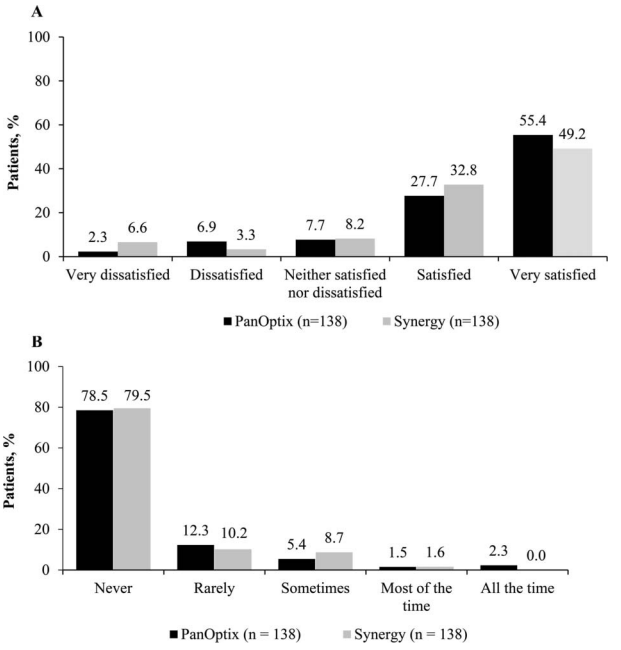


Figure 4. Patient-reported spectacle independence and satisfaction at 6 months. *A*: Satisfaction with vision[a] at 6 months. *B*: Spectacle independence[b] at 6 months. IOLSAT = IOL satisfaction. [a]Response to the IOLSAT questionnaire: Overall, in the past 7 days, how satisfied were you with your vision? [b]Response to the IOLSAT questionnaire: In the past 7 days, how often did you need to wear eyeglasses to see?

3 months postoperatively, favoring the Synergy IOLs, although such differences may not be clinically relevant (<1 line).[20] Our study results cannot be compared directly with Dick et al. due to differences in enrollment between the 2 studies (1:1 in our study [n = 138 per group] vs 1:2 [PanOptix, n = 52; Synergy, n = 95] in Dick et al). Furthermore, Moshirfar et al. (retrospective study) reported that Synergy IOL (DFR00V) provided 4 letters better monocular UNVA (40 cm) than the PanOptix IOL (TFAT00) at 6 months (0.10 ± 0.07 vs 0.18 ± 0.14 logMAR), when the PanOptix group showed more hyperopic residual refractive error vs Synergy group (0.30 ± 0.31 D vs 0.013 ± 0.44 D, P = .02).[19] Similarly, Nomura et al., in a case comparative study, observed a difference of 2.5 letters for binocular UNVA at 40 cm in favor of Synergy vs PanOptix (n = 27 per group; −0.07 ± 0.07 vs −0.02 ± 0.07 logMAR); the mean manifest refraction of the PanOptix group showed a significant hyperopic shift vs Synergy group (0.22 ± 0.34 D vs −0.08 ± 0.28 D, P < .001).[22] Consistently, the study did not find significant differences between the 2 groups on binocular DCNVA (40 cm and 30 cm). Overall, the differences in findings across studies may be attributed to several factors such as differences in sample size, uneven distribution of sample size between groups, follow-up time, patients' age range, and residual refractive error when UCVAs were compared.

Measurement of defocus curve with the study IOLs allows determining the visual performance across all simulated distances. In this study, both IOLs provided satisfactory VAs from distance to near at 33 cm, corroborating with the VAs measured at all distances in this study, and similar to the published research on PanOptix and Synergy.[30,32] In addition, despite the limitation of measuring binocular instead of monocular defocus curves, VA defocus curves from both IOLs showed a similar full range of field profiles with a smooth transition (≥0.05 and <0.14 logMAR) from intermediate to near vision.[33,34]

The optical design of Synergy IOL with chromatic aberration correction is said to improve image contrast. However, this study found no significant difference in contrast sensitivity between PanOptix and Synergy IOLs in both photopic and mesopic conditions, consistent with the Normura study.[22]

Diffractive multifocal IOLs are often associated with visual disturbances such as starbursts, halos, and glare which leads to

patient's dissatisfaction.[10,35–37] In this study, the visual disturbances were evaluated through the validated QUVID questionnaire that uses common visual phenomena images. A higher proportion of patients with Synergy (vs PanOptix) experienced starbursts and glare at 6 months. Nomura et al. reported a higher trend for glare and halo in Synergy (vs PanOptix).[22] Dick et al. reported similar nondirected monocular patient reports and observed a trend of more starbursts and glare with Synergy than PanOptix.[20] Ferreira et al. reported a similar frequency of visual disturbances between the 2 IOLs.[21]

Both PanOptix and Synergy groups in our study demonstrated good overall patient satisfaction. Most patients with both IOLs reported that they were "satisfied" or "very satisfied" with their vision at 6 months postoperatively, which is in agreement with previous studies.[8,15,38,39] The safety findings were also comparable between the study IOLs.

This study has a few limitations. Owing to the extremely slow enrollment at one site, it was excluded from the study, and more patients than initially planned were added to other sites. Nevertheless, a sufficient number of patients were enrolled, and sample size for the analysis was adequately powered. Furthermore, all patients enrolled in this study were healthy cataract patients with preoperative astigmatism of ≤0.75 D, and no toric IOLs were used.

In conclusion, PanOptix IOL demonstrated a good and full range of vision (distance to near at 33 cm) similar to Synergy IOLs in both photopic and mesopic conditions. Most patients were spectacle-independent and reported high overall vision satisfaction with both IOLs. PanOptix IOL demonstrated lower visual disturbances of starbursts and glare than Synergy IOL.

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WHAT WAS KNOWN

- Presbyopia-correcting IOLs such as diffractive multifocal IOLs demonstrate higher rates of visual disturbance than monofocal IOLs and, thus, may lead to higher patient dissatisfaction.
- The AcrySof IQ PanOptix is a trifocal IOL that mitigates the effects of presbyopia by providing improved intermediate and near VA while maintaining comparable distance VA than monofocal IOLs.
- The TECNIS Synergy IOL, a combination of diffractive extended depth-of-focus and bifocal designs allows patients to experience a continuous range of vision (far-near) even under low-light conditions.

WHAT THIS PAPER ADDS

- Results from this prospective, multicenter, randomized, patient and examiner—masked bilateral study showed that PanOptix IOLs provided a comparable range of vision to Synergy IOLs from distance to near (33 cm) and similar contrast sensitivity under both photopic and mesopic conditions.
- PanOptix demonstrated lower visual disturbances of starbursts and glare than Synergy. Most patients implanted with PanOptix and Synergy IOLs had spectacle independence and high satisfaction with vision.

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