• Clinical Research •

Comparison of visual outcomes and optical performance between Eyhance ICB00 and Lentis Comfort LS-313 MF15 intraocular lenses

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Abstract

● **AIM:** To compare the postoperative visual outcomes and optical performance of the Eyhance ICB00 and Lentis Comfort LS-313 MF15 intraocular lenses (IOLs).

● **METHODS:** Patients who underwent phacoemulsification with bilateral IOL implantation, receiving the ICB00 IOL in one eye and the LS-313 MF15 IOL in the fellow eye, were enrolled in this retrospective study. Postoperative visual acuities, including corrected distance visual acuity (CDVA) and intermediate and near visual acuities, and monocular and binocular defocus curves were measured. Postoperative incidences of visual disturbances were also assessed. Optical bench testing evaluated the modulation transfer function (MTF) values at various defocus levels.

● **RESULTS:** The study included 52 eyes from 26 patients (16 females; 61.5%) who underwent ICB00 IOL implantation in one eye (26 eyes) and LS-313 MF15 IOL implantation in the opposite eye (26 eyes). The mean patient age was 69.2±8.4y (range, 55–84y). Both IOLs achieved excellent postoperative CDVA of 20/20 or better without significant differences between groups (88.5% *vs* 92.3%). Intermediate and near visual acuity were better in the LS-313 MF15 group compared with the ICB00 group, whereas the frequency of glare, starbursts, and halos was comparable between groups. The binocular defocus curve demonstrated better visual performance across defocus levels compared with both monocular curves, and the LS-313 MF15 group showed better visual acuity than the ICB00 group at negative defocus levels. Optical bench testing demonstrated that the LS-313 MF15 IOL provided higher MTF values at negative defocus levels compared with the ICB00 IOL.

● **CONCLUSION:** The LS-313 MF15 IOL demonstrates a significant advantage over the ICB00 IOL regarding intermediate and near visual acuity. The LS-313 MF15 exhibits superior optical performance on bench testing, suggesting better functional outcomes for patients requiring a broader vision range.

● **KEYWORDS:** monofocal plus; extended depth of focus; mix-and-match; intraocular lens

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INTRODUCTION

In cataract surgery, intraocular lenses (IOLs) are customized and implanted to replace the human crystalline lens, aiming to restore or enhance visual function[1]. Since Sir Harold Ridley introduced the concept of IOL implantation, advancements have progressed from traditional monofocal IOLs to more complex designs such as bifocal, accommodating, trifocal, extended depth of focus (EDoF), and monofocal plus lenses,

all developed to address varying visual demands after surgery and to improve overall patient satisfaction[1-5].

IOLs with high near-add powers often lead to visual disturbances, such as dysphotopsia, which can negatively affect patient satisfaction[6-10]. Consequently, multifocal IOLs with reduced near addition and various enhanced intermediate vision IOLs have been developed to improve intermediate vision while minimizing or avoiding dysphotopsia[11-14]. These intermediate-vision-focused IOLs are generally classified into EDoF and monofocal plus categories, depending on the extent to which they extend the depth of focus[4-5,15-16].

Enhanced intermediate vision IOLs typically provide inferior near vision compared to bifocal and trifocal IOLs[17-20]. Therefore, techniques such as mini- or micro-monovision are often employed to supplement near vision in patients receiving these IOLs[5,16,21-22]. A mix-and-match implantation strategy involving multifocal IOLs with different add powers is also employed to optimize visual performance across the full range of distances, from near to far[23-24]. Previous studies demonstrated that this approach can synergistically combine the benefits of each IOL's specific add power[24-27]. Therefore, binocular defocus curves in patients with mix-and-match multifocal IOL implantation may be superior to the monocular defocus curves of each IOL in the same patient[24-27]. This study was conducted to evaluate the outcomes of combining EDoF and monofocal plus IOLs using a mix-and-match implantation strategy. Optical bench testing assessed the optical characteristics of each lens type, and a clinical study was performed to determine real-world visual performance.

PARTICIPANTS AND METHODS

Ethical Approval Ethical approval was granted by the Institutional Review Board of Korea University Ansan Hospital (IRB No.2024AS0191), and the study complied with the tenets of the Declaration of Helsinki. Due to its retrospective design, the requirement for written informed consent was waived.

This retrospective cross-sectional study included patients who underwent phacoemulsification with bilateral implantation of ICB00 IOL (the ICB00 group) and LS-313 MF15 IOL (the LS-313 MF15 group) at the Korea University Ansan Hospital from September 2023 to July 2024. Inclusion criteria were limited to individuals with postoperative corrected distance visual acuity (CDVA) of 20/40 or better in both eyes. Exclusion criteria included traumatic cataracts, any prior ocular surgeries, intraoperative complications such as posterior capsular rupture, and any postoperative adverse events.

All participants underwent comprehensive preoperative ophthalmic examinations, including slit-lamp biomicroscopy, fundoscopy, and noncontact specular microscopy. Axial length and other biometric parameters were measured using the IOLMaster 700 (Carl Zeiss Meditec, Jena, Germany), and IOL power was calculated based on the Barrett Universal II formula. The lens constants applied were +2.09 for the Eyhance ICB00 IOL and +1.53 for the Lentis Comfort LS-313 MF15 IOL.

A single experienced surgeon (Eom Y) performed all surgeries using topical anesthesia with 0.5% proparacaine hydrochloride (Paracaine, Hanmi Pharm, Seoul, Republic of Korea). The surgical approach included a 2.75 mm clear corneal incision, followed by the creation of a continuous curvilinear capsulorrhexis slightly smaller than the IOL optic using a 26-gauge needle and capsulorrhexis forceps. The phacoemulsification was carried out using the phaco-chop technique with the Stellaris Elite™ system (Bausch & Lomb, Inc., USA), and IOLs were implanted into the capsular bag *via* an injector system. For the mix-and-match strategy, the ICB00 IOL was preferentially implanted in the dominant eye to optimize distance and intermediate vision, while the LS-313 MF15 was implanted in the fellow eye to enhance near vision.

Postoperative refractive status was assessed using manifest refraction at a 4-meter distance between 4 and 8wk post-surgery. Visual acuity assessments included monocular uncorrected distance visual acuity (UDVA) and CDVA at 4 m; uncorrected and distance-corrected intermediate visual acuity (UIVA, DCIVA) at 66 cm; and uncorrected and distance-corrected near visual acuity (UNVA, DCNVA) at 40 cm. Additionally, defocus curves under distance-corrected conditions were measured monocularly and binocularly at 4 m, across defocus levels ranging from -3.00 to +1.00 D in 0.50 D increments.

Patients were surveyed for photic phenomena—such as glare, halos, and starbursts—using a structured, self-administered questionnaire conducted 4 to 8wk after surgery. Visual aids were included to help participants better identify and report any photic symptoms they experienced postoperatively[11,24,28-29].

The study also incorporated optical bench testing to evaluate the optical quality of each IOL. The setup consisted of a 555-nm LED light source illuminating a 1951 United States Air Force (USAF) resolution test chart, along with a model eye system comprising a CMOS camera (BFS-U3-120S4M-CS; FLIR Systems Inc., Wilsonville, OR, USA), artificial pupil, trial lenses, and a pupil camera[11,30]. The model eye incorporated a neutral aspheric artificial cornea and a wet cell made from N-BK7 glass filled with balanced salt solution. Each IOL was mounted using a lens adapter on an XYZ translation stage to ensure precise axial alignment and focus on the camera sensor. The trial lens adjusted the focus to capture defocus images ranging from -2.50 to +1.00 D at 0.25 D intervals.

Optical performance was compared across three IOLs (20.0 D)—LS-313 MF15, ICB00, and ZCB00—by imaging

Table 1 Preoperative clinical characteristics of patients

Parameters	ICB00	LS-313 MF15	*P*
Laterality, right/left, *n* (%)	23 (88.5)/3 (11.5)	3 (11.5)/23 (88.5)	<0.001[b]
UDVA, logMAR	0.38±0.47	0.31±0.17	0.420[a]
Keratometry, D	44.58±1.49	44.38±1.53	0.128[a]
Keratometric astigmatism, D	0.98±0.69	1.16±1.08	0.288[a]
Total keratometry, D	44.54±1.50	44.36±1.57	0.178[a]
Total keratometric astigmatism, D	1.02±0.61	1.25±1.09	0.205[a]
Anterior chamber depth, mm	3.09±0.35	3.12±0.35	0.128[a]
Axial length, mm	23.73±1.22	24.05±2.19	0.386[a]

Keratometry, keratometric astigmatism, total keratometry, total keratometric astigmatism, anterior chamber depth, and axial length were measured using an IOLMaster 700 (Carl Zeiss Meditec, Jena, Germany). UDVA: Uncorrected distance visual acuity; logMAR: Logarithm of the minimum angle of resolution; D: Diopters. [a]Paired *t*-test; [b]McNemar test.

the 1951 USAF chart, according to ISO 11979-2 standards concerning optical properties and testing methods. Specifically, element 3 of group 2 on the chart, representing 15 cycles per degree (equivalent to 20/40 visual acuity) was used for evaluation. Acquired images were processed using MATLAB (MathWorks, Natick, MA, USA) to generate through-focus modulation transfer function (MTF) curves along horizontal and vertical axes. The image quality was quantified by calculating the root mean square (RMS) of the MTF (MTF_{RMS}) across these axes[30-31]:

$$MTF_{RMS} = \sqrt{\frac{MTF_{Horizontal}^2 + MTF_{Vertical}^2}{2}}$$

The primary endpoint was DCIVA. Given the retrospective study design, a post-hoc power analysis was performed using the Difference between two dependent means (matched pairs) option of G*power, version 3.1.9.6 (Franz Faul, Christian-Albrechts-Universität, Kiel, Germany).

Statistical Analysis Statistical analyses were performed using SPSS Statistics version 20 (IBM Corp., Armonk, NY, USA). To assess differences in preoperative and postoperative measurements between the two study groups, paired *t*-tests were applied for continuous variables, whereas McNemar's test was used for categorical data. Additionally, McNemar's test was used to evaluate and compare the proportion of eyes in each group that achieved cumulative Snellen visual acuity thresholds of 20/x or better at far, intermediate, and near distances (UDVA, CDVA, UIVA, DCIVA, UNVA, and DCNVA). Defocus curve data were analyzed using a linear mixed-effects model to account for repeated measurements across defocus levels and within-subject correlation in the contralateral-eye design. Exploratory point-specific comparisons across defocus levels were adjusted for multiplicity using the Holm–Bonferroni method. A *P*-value of less than 0.05 was considered to indicate statistical significance.

RESULTS

The study included 52 eyes from 26 patients (16 females; 61.5%) who underwent ICB00 IOL implantation in one eye (26 eyes) and LS-313 MF15 IOL implantation in the opposite eye (26 eyes). The mean patient age was 69.2±8.4y (range, 55–84y). The ICB00 IOL was predominantly implanted in the right eye (88.5%; *P*<0.001). There were no significant differences in preoperative UDVA, keratometry, keratometric astigmatism, total keratometry, total keratometric astigmatism, anterior chamber depth, and axial length between the two groups (Table 1).

There were no significant differences in the postoperative residual sphere (-0.15±0.54 and -0.30±0.50 D), cylinder (-0.33±0.59 and -0.14±0.36 D), and spherical equivalent (-0.32±0.45 and -0.37±0.56 D) between ICB00 and LS-313 MF15 groups. The mean monocular 4-m UDVA and CDVA, showing no significant differences between the two groups, were 0.04±0.06 and -0.02±0.07 logarithm of the minimum angle of resolution (logMAR) in the ICB00 group, respectively, and 0.05±0.09 and -0.03±0.09 logMAR in the LS-313 MF15 group, respectively. However, the mean monocular UIVA, DCIVA, UNVA, and DCNVA in the LS-313 MF15 group (0.08±0.08, 0.11±0.09, 0.26±0.11, and 0.25±0.12 logMAR, respectively) were significantly better compared to the ICB00 group (0.16±0.09, 0.20±0.10, 0.41±0.13, and 0.43±0.11 logMAR, respectively; Table 2).

Figure 1 shows the postoperative cumulative Snellen visual acuity of UDVA, CDVA, UIVA, DCIVA, UNVA, and DCNVA in the two groups. The UDVA of 20/20 or better was achieved in 17 eyes (65.4%) in the ICB00 group compared to 19 eyes (73.1%) in the LS-313 MF15 group, showing no statistically significant difference between the groups (*P*=0.688). Similarly, the CDVA of 20/20 or better was attained by 23 eyes (88.5%) in the ICB00 group and 24 eyes (92.3%) in the LS-313 MF15 group, demonstrating no significant difference between the groups (*P*>0.999).

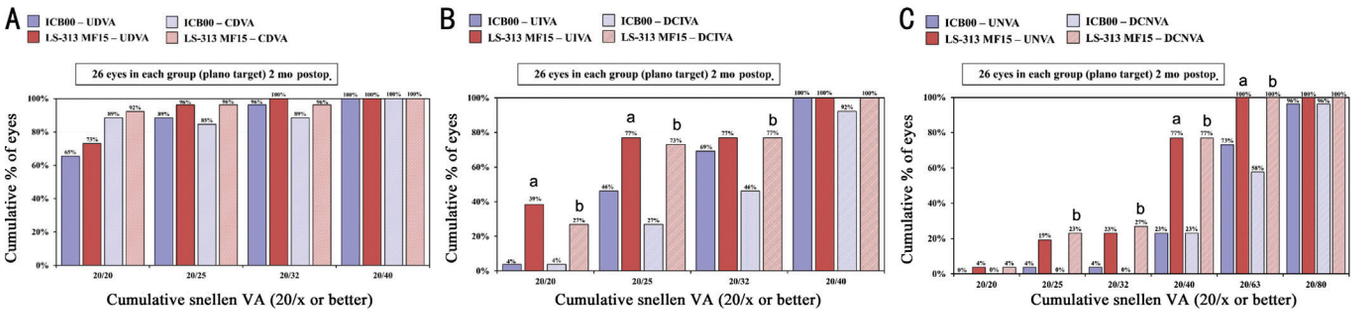


Figure 1 Comparison of the postoperative cumulative Snellen visual acuity of UDVA and CDVA (A), UIVA and DCIVA (B), and UNVA and DCNVA (C) between the ICB00 and LS-313 MF15 groups [a]*P*<0.05 in UIVA or UNVA between the two groups; [b]*P*<0.05 in DCIVA or DCNVA between the groups. All statistical analyses were conducted using the McNemar test. UDVA: Uncorrected distance visual acuity; CDVA: Corrected distance visual acuity; UIVA: Uncorrected intermediate visual acuity; DCIVA: Distance-corrected intermediate visual acuity; UNVA: Uncorrected near visual acuity; DCNVA: Distance-corrected near visual acuity.

Table 2 Postoperative residual refractive error and visual acuities

Parameters	ICB00	LS-313 MF15	Between-group mean difference (95%CI)	*P*[a]
Residual refractive error				
Sphere, D	-0.15±0.54	-0.30±0.50	0.14 (-0.01 to 0.30)	0.070
Cylinder, D	-0.33±0.59	-0.14±0.36	-0.18 (-0.43 to 0.06)	0.129
Spherical equivalent, D	-0.32±0.45	-0.37±0.56	0.05 (-0.10 to 0.20)	0.479
Visual acuity, logMAR				
UDVA, 4 m	0.04±0.06	0.05±0.09	-0.01 (-0.04 to 0.02)	0.531
CDVA, 4 m	-0.02±0.07	-0.03±0.09	0.02 (-0.01 to 0.04)	0.140
UIVA, 66 cm	0.16±0.09	0.08±0.08	0.08 (0.04 to 0.11)	<0.001
DCIVA, 66 cm	0.20±0.10	0.11±0.09	0.10 (0.06 to 0.14)	<0.001
UNVA, 40 cm	0.41±0.13	0.26±0.11	0.15 (0.10 to 0.20)	<0.001
DCNVA, 40 cm	0.43±0.11	0.25±0.12	0.19 (0.13 to 0.24)	<0.001

[a]Paired *t*-test. CI: Confidence interval; D: Diopters; logMAR: Logarithm of the minimum angle of resolution; UDVA: Uncorrected distance visual acuity; CDVA: Corrected distance visual acuity; UIVA: Uncorrected intermediate visual acuity; DCIVA: Distance-corrected intermediate visual acuity; UNVA: Uncorrected near visual acuity; DCNVA: Distance-corrected near visual acuity.

However, the LS-313 MF15 group showed a significantly higher proportion of eyes achieving UIVA and DCIVA of 20/20 or better and 20/25 or better, as well as DCIVA of 20/32 or better, compared with the ICB00 group. DCIVA of 20/20 was achieved in 1 eye (3.8%) in the ICB00 group and 7 eyes (26.9%) in the LS-313 MF15 group (*P*=0.031). DCIVA of 20/25 or better was observed in 7 eyes (26.9%) and 19 eyes (73.1%), respectively (*P*<0.001). DCIVA of 20/32 or better was observed in 12 eyes (46.2%) and 20 eyes (76.9%), respectively (*P*=0.008).

The UNVA of 20/40 or better was achieved by a significantly greater number of eyes in the LS-313 MF15 group (20 eyes, 76.9%) compared to the ICB00 group (6 eyes, 23.1%, *P*<0.001). Similarly, the DCNVA of 20/40 or better was obtained by a significantly higher number of eyes in the LS-313 MF15 group (20 eyes, 76.9%) compared to the ICB00 group (6 eyes, 23.1%, *P*<0.001).

Figure 2 displays the binocular and monocular distance-corrected defocus curves at 2mo after cataract surgery. All three curves peaked at 0 D and declined with increasing negative defocus. Mixed-effects modeling demonstrated a significant condition×defocus interaction (*P*<0.001), indicating differences in defocus curve profiles among conditions. Exploratory point-specific comparisons across defocus levels (Holm–Bonferroni adjusted) showed that LS-313 MF15-implanted eyes performed better than ICB00-implanted eyes at negative defocus levels from -1.0 to -3.0 D (all adjusted *P*<0.05). Binocular performance was better than ICB00-implanted eyes across all defocus levels (all adjusted *P*<0.05). Compared with LS-313 MF15-implanted eyes, binocular performance showed small but statistically significant differences across defocus levels after multiplicity adjustment (all adjusted *P*<0.05).

Table 3 indicates that the incidences of glare (19.2% and 15.4%), starbursts (15.4% and 19.2%), and halos (7.7% and 11.5%) were comparable between the two groups.

Figure 3 presents the images of the 1951 USAF resolution test chart captured through three different IOLs. Although images from all three IOLs began to blur progressively with the addition of negative diopters, the images obtained through the ICB00 IOL and LS-313 MF15 IOL remained distinguishable

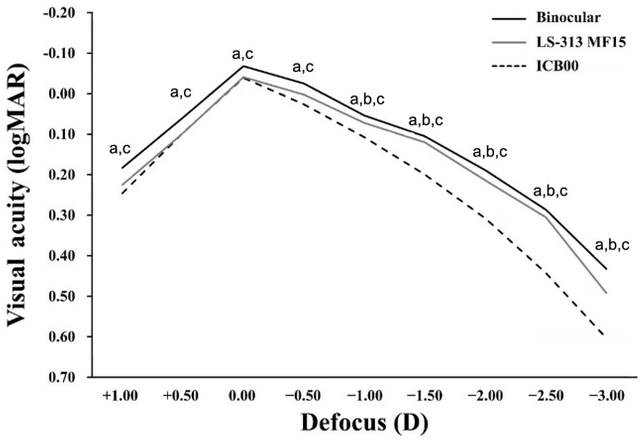


Figure 2 Mean distance-corrected binocular defocus curve compared with monocular defocus curves of the LS-313 MF15 and ICB00, measured 2mo after mix-and-match implantation Overall differences in defocus curve profiles were evaluated using a linear mixed-effects model accounting for repeated measurements across defocus levels and within-subject correlation (condition×defocus interaction, P<0.001). Exploratory point-specific comparisons across defocus levels were adjusted for multiplicity using the Holm–Bonferroni method. [a]P<0.05 between binocular and LS-313 MF15 curves; [b]P<0.05 between LS-313 MF15 and ICB00 curves; [c]P<0.05 between binocular and ICB00 curves (Holm-adjusted). D: Diopters; logMAR: Logarithm of the minimum angle of resolution.

Table 3 Postoperative incidences of glare, starbursts, and halos n (%)

Parameters	ICB00	LS-313 MF15	P[a]
Glare	5 (19.2)	4 (15.4)	>0.999
Starbursts	4 (15.4)	5 (19.2)	>0.999
Halos	2 (7.7)	3 (11.5)	>0.999

[a]McNemar test.

until an additional -2.00 and -2.50 D, respectively. In contrast, images captured with the ZCB00 IOL became indistinguishable at -1.00 D of defocus.

An MTF analysis showed that the LS-313 MF15 IOL had higher MTF_{RMS} values at -0.50 to -2.50 D of defocus (0.401, 0.330, 0.293, 0.274, 0.261, 0.210, 0.198, 0.119, and 0.049, respectively) compared to the ICB00 IOL (0.324, 0.224, 0.210, 0.209, 0.173, 0.152, 0.118, 0.080, and 0.017, respectively). The ICB00 IOL had higher MTF_{RMS} values at -0.75 to -2.50 D of defocus compared to the ZCB00 IOL (0.115, 0.052, 0.000, 0.000, 0.000, 0.000, 0.000, and 0.000, respectively; Figure 4).

The DCIVA in the LS-313 MF15 and ICB00 groups were 0.11±0.09 and 0.20±0.10 logMAR, respectively. From these values, the effect size was calculated as 0.9434 in a post-hoc power analysis. The effect size of 0.9434 and a two-tailed alpha of 0.05 in the subgroup analysis with 26 eyes of each group led to a power of 0.99.

DISCUSSION

This study compared visual outcomes and optical performance of LS-313 MF15 and ICB00 IOLs through a clinical study and optical bench testing. The LS-313 MF15 IOL provided UDVA and CDVA comparable to the ICB00 IOL and significantly better visual acuity at near and intermediate distances. Moreover, the LS-313 MF15 IOL did not increase the incidence of visual disturbances (glare, halos, or starbursts) compared to the ICB00 IOL. Therefore, the LS-313 MF15 IOL can be effectively used as a safe and efficient EDoF IOL for cataract patients seeking excellent far and intermediate vision without bothersome optical phenomena.

Although not accepted by all ophthalmologists, enhanced intermediate vision IOLs are classified into EDoF and monofocal plus IOLs. According to the ANSI standards[15], EDoF IOLs must meet four key criteria: a minimum increase in the depth of focus of 0.5 D at a visual acuity of 0.2 logMAR, the visual acuity at an intermediate distance of 66 cm surpassing that provided by a monofocal IOL, the visual acuity at an intermediate distance of 66 cm achieving or exceeding a visual acuity of 0.2 logMAR, and not compromised distance visual acuity when compared to a monofocal IOL. In previous studies, the LS-313 MF15 IOL met all four criteria[32], whereas the ICB00 IOL met only three, failing to achieve a minimum increase in depth of focus of 0.5 D at a visual acuity of 0.2 logMAR[33]. Thus, the LS-313 MF15 IOL adheres more closely to the ideal performance benchmarks for an EDoF IOL. The results of this study align with previous findings, which showed that the LS-313 MF15 IOL provides better performance in near and intermediate vision compared to the ICB00 IOL, without increasing optical dysphotopsia.

The binocular defocus curve showed improved visual performance compared with monocular performance in both ICB00- and LS-313 MF15-implanted eyes. However, the difference between LS-313 MF15- and ICB00-implanted eyes appeared greater than the difference between binocular performance and LS-313 MF15-implanted eyes, suggesting that the intrinsic optical characteristics of the LS-313 MF15 may contribute more substantially to overall defocus performance. This may be explained by the superior optical performance and extended depth of focus of the LS-313 MF15 compared with the ICB00. Previous studies have demonstrated that bilateral defocus curves provide better visual acuity within certain defocus ranges with bilateral multifocal or EDoF IOL implantation[8-9,16,24]. Although a mix-and-match strategy using ICB00 and LS-313 MF15 IOLs may offer practical or cost-related advantages, the additional benefit over LS-313 MF15 alone appeared modest.

A previous study compared postoperative outcomes between the LS-313 MF15 and ICB00 IOLs and reported generally comparable visual performance at far, intermediate, and near distances[34]. In contrast, the present study evaluated a

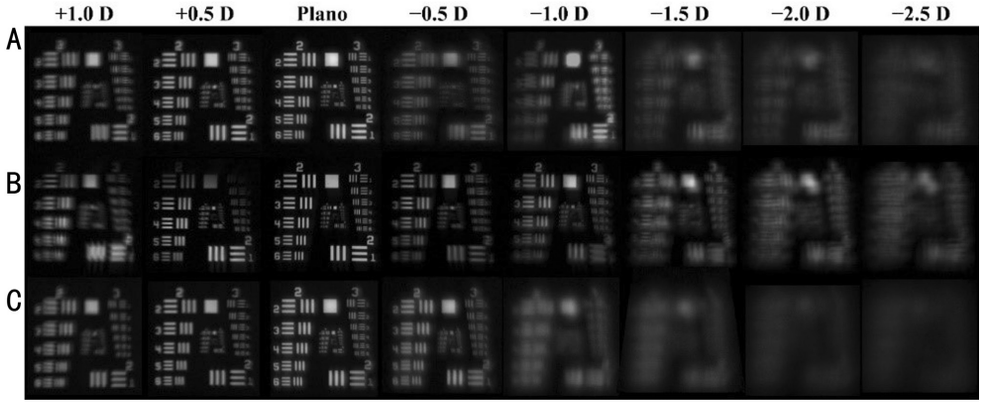


Figure 3 Captured images of the 1951 United States Air Force resolution test chart at a 3.0-mm pupil size through the ICB00 (A), LS-313 MF15 (B), and ZCB00 (C) intraocular lenses Minus defocus represents near distance.

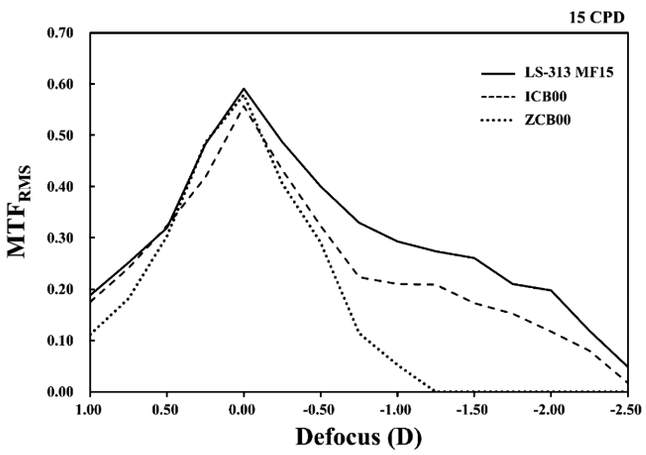


Figure 4 Comparison of the root mean square of the modulation transfer function (MTF_{RMS}) values measured at 15 cycles per degree (CPD) with a 3.0-mm pupil size among the LS-313 MF15, ICB00, and ZCB00 intraocular lenses.

contralateral-eye mix-and-match strategy, enabling within-subject comparisons while minimizing inter-individual variability. By integrating clinical visual outcomes with optical bench data, our study provides further insight into the functional implications of combining these two IOL platforms and offers a clinically relevant perspective on binocular visual performance after mix-and-match implantation. Importantly, our contralateral-eye design further highlights differences in optical performance at intermediate and near distances between the two IOL platforms that may not be fully captured in cohort-based comparisons.

In the present study, IOL allocation followed a dominance-based "mix-and-match" strategy to optimize binocular visual outcomes. Specifically, the ICB00 IOL was implanted in the dominant eye to prioritize distance and intermediate vision, whereas the LS-313 MF15 IOL was allocated to the non-dominant eye to enhance near visual performance. This approach is consistent with established clinical practice aimed at achieving a functional range of vision and maximizing patient satisfaction[8,16,35-36]. Therefore, the observed laterality pattern reflects deliberate surgical intent rather than systematic allocation bias. Nevertheless, ocular dominance was determined by patient self-report and may be subject to misclassification[37]. Moreover, previous studies have shown that ocular dominance can shift after cataract surgery, suggesting that preoperative dominance may not always remain stable postoperatively[38-39].

This study found no significant differences in the perception of optical phenomena (glare, halos, and starbursts) between eyes with LS-313 MF15 and ICB00 IOLs. A higher incidence of optical disturbances was anticipated in eyes with the LS-313 MF15 IOL given its sectorial add-segment design. However, the results contradicted this expectation. The lack of significant differences in optical phenomena could be explained by the relatively low near add power of 1.5 D and the presence of a transition zone between distance and near segments in the LS-313 MF15 IOL. This design may help minimize the likelihood of visual disturbances typically associated with multifocal IOLs.

This study has several limitations. First, the relatively small sample size and retrospective design precluded an *a priori* sample size calculation and may limit the power to detect low-incidence photic phenomena, although post-hoc analysis suggested adequate power for detecting differences in DCIVA. Second, photic phenomena were assessed using a non-validated questionnaire without formal grading of symptom severity, which may affect the accuracy and comparability of patient-reported outcomes. Third, the short follow-up period (4–8wk) may be insufficient to fully capture neuroadaptation and long-term dysphotopsia, as visual symptoms and patient adaptation typically evolve over time; therefore, visual disturbance outcomes should be interpreted with caution. Fourth, because ICB00 and LS-313 MF15 IOLs were implanted only in eyes without ocular comorbidities, our findings may not be generalizable to patients with reduced

visual potential. Fifth, each group included both Toric and non-Toric IOLs, although the optical platforms were identical. Lastly, although binocular and monocular defocus curves were evaluated clinically, optical bench testing was conducted under monocular conditions at a single spatial frequency, which may limit the generalizability of the optical performance findings. Therefore, large-scale prospective studies with longer follow-up, using validated patient-reported outcome measures and structured severity grading, are warranted to better define the additional contribution of binocular depth of focus in mix-and-match IOL strategies.

In conclusion, the LS-313 MF15 IOL provided superior near and intermediate visual performance with similar distance vision and a comparable profile of photic phenomena compared with the ICB00 IOL. Binocular defocus performance was statistically superior to monocular LS-313 MF15 performance. However, the magnitude of improvement was modest and substantially smaller than the difference observed between LS-313 MF15 and ICB00. These findings suggest that the intrinsic optical characteristics of the LS-313 MF15 play an important role in determining visual outcomes in a mix-and-match strategy. Further studies directly comparing different bilateral implantation strategies are warranted to clarify the optimal approach for achieving a broad range of vision.

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Data Availability Statement: The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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