Comparison of the visual performance and quality of vision with combined symmetrical inferonasal near addition versus inferonasal and superotemporal placement of rotationally asymmetric refractive multifocal intraocular lenses

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PURPOSE: To compare the postoperative quality of vision between different bilateral placements of near segments of rotationally asymmetric refractive multifocal intraocular lenses (IOLs) and to determine how this affects visual performance.

SETTING: Cathedral Eye Clinic, Belfast, Northern Ireland, United Kingdom.

DESIGN: Retrospective comparative case series.

METHODS: The study enrolled consecutive patients having refractive lens exchange and implantation of rotationally asymmetric multifocal IOLs. Group 1 received bilateral SBL-3 IOLs and Group 2 received bilateral Lentis Mplus LS-312 MF30 IOLs, with the near segments placed inferonasally in each group. Group 3 received a Lentis Mplus LS-312 MF20 IOL in the dominant eye with the near segment positioned superotemporal and a Lenstec SBL-3 IOL positioned inferonasally in the fellow eye. Binocular uncorrected (UDVA) and corrected distance visual acuities, binocular uncorrected near (UNVA) and intermediate (UIVA) visual acuities, binocular distance-corrected near and intermediate visual acuities, and quality of vision were evaluated over 3 months postoperatively.

RESULTS: The study enrolled 180 patients (360 eyes). There was no significant difference between the groups in binocular UDVA, UIVA, and UNVA; however, there was a significant difference between the groups in quality of vision ($P \leq .001$). Group 3 had significantly better overall quality of vision.

CONCLUSION: When implanting rotationally asymmetric multifocal IOLs, a combination of superotemporal placement of the near segment (+2.00 diopter [D] addition [add]) in the dominant eye with inferonasal placement of the near segment (+3.00 D add) in the fellow eye yielded consistent, high overall quality of vision and uncorrected visual acuity.

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Rotationally asymmetric refractive multifocal intraocular lenses (IOLs) have been used in modern lens-based surgery for the past 7 years. The Lentis Mplus (Oculentis GmbH) was the first commercially available asymmetric multifocal IOL, and many studies[1–5] have outlined its performance, advantages, and shortcomings. A second asymmetric multifocal IOL, the SBL-3 (Lenstec, Inc.), has since been

introduced and an initial study by Venter et al.[6] found that this multifocal IOL also provides a good range of near, intermediate, and distance vision.

Asymmetric multifocal IOLs provide their multifocality through a refractive design by incorporating a near vision section in the IOL. Therefore, the IOL has 2 sections—a larger distance section and a smaller reading segment—creating only 1 transition zone. Because of the design of rotationally asymmetric multifocal IOLs, the position of the near segment must be considered. An asymmetric multifocal IOL can be placed in numerous rotational positions. This differs from previous multifocal IOL designs in which the IOL consisted of concentric rings, making the multifocal IOL rotationally symmetric; therefore, the rotational position of the IOL had no effect on IOL performance. The recommended placement of the reading segment when implanting either asymmetric multifocal IOL is inferiorly with slight nasal deviation; however, the near segment can be placed in various positions without significantly affecting the visual performance of the multifocal IOL. This was confirmed in a study by de Wit et al.,[7] which found that superotemporal placement was well tolerated, and anecdotal findings suggest superotemporal placement reduces dysphotopsias.

In addition to multifocal IOL placement, the appropriate selection of a reading addition (add) must also be considered because the Lentis Mplus IOL is now available in a range of near adds (+1.50 diopter [D], +2.00 D, and +3.00 D). Lower powered near-add multifocal IOLs have been found to provide good distance and intermediate vision, albeit with reduced near vision.[8] Another study found a combination of a lower add in the dominant eye combined with a high-powered add provided good visual acuity and quality of life.[9] These studies show that variation from the normal placement and that a combination of high-powered and low-powered adds provide good postoperative outcomes; however, this has not been fully evaluated.

Therefore, this study compared the visual function and overall postoperative quality of vision achieved between asymmetric multifocal IOLs with variations in near segment placements and adds. We compared lower powered add asymmetric multifocal IOLs with superotemporal placement in the dominant eye combined with inferonasal placement in the nondominant eye with asymmetric multifocal IOLs with near segments placed inferonasally in each eye. This will provide surgeons with information to provide optimum postoperative satisfaction after rotationally asymmetric multifocal IOL implantation.

PATIENTS AND METHODS

This retrospective nonrandomized study recruited consecutive patients having refractive lens exchange followed by implantation of a rotationally asymmetric multifocal IOL. All patients provided informed consent. The research adhered to the tenets of the Declaration of Helsinki and was approved by the local research ethics committee. The patients were advised of the possible risks associated with the operation and the possible necessity for further corneal laser refractive surgery.

Patients were divided into 3 groups based on the position of the near segment. Group 1 received bilateral SBL-3 IOLs with inferonasal placement of the near segment in each eye. Group 2 received a Lentis Mplus LS-312 MF30 IOL with the near segment positioned inferonasally in both eyes. Group 3 received a Lentis Mplus LS-312 MF20 IOL with superotemporal near segment placement in the dominant eye and a SBL-3 IOL in the fellow eye with inferonasal placement. Figure 1 shows clinical retroillumination images of the multifocal IOL near segment positions.

Exclusion criteria were a history of glaucoma or retinal detachment, ocular inflammation, corneal surgery or disease, neuro-ophthalmic disease, and macular disease.

Patient Assessment

A full ophthalmologic assessment was performed on all patients preoperatively. The examination included a medical history, keratometry, topography, and autorefraction (OPD-Scan II ARK-10000, Nidek Co., Ltd), subjective refraction (RT-5100 Auto Phoropter Head, Nidek Co., Ltd), uncorrected (UDVA) and corrected (CDVA) distance visual acuities, uncorrected near (UNVA) and intermediate (UIVA) visual acuities, distance-corrected near and distance-corrected intermediate visual acuities, slitlamp examination, Goldmann tonometry, dilated fundoscopy, and retinal optical coherence tomography (Cirrus 4000; Carl Zeiss Meditec AG). Biometry was performed using partial coherence interferometry (PCI) (IOLMaster, Carl Zeiss Meditec AG). The PCI device measured corneal curvature, anterior chamber depth, and axial length (AL) for subsequent IOL calculation using the Hoffer Q formula[10] for eyes with an AL less than 22.0 mm and SRK/T formula[11] for eyes with an AL of 22 mm or more. Visual acuity measurements were evaluated with logMAR charts for distance (6 m) and with Radner reading charts for near and intermediate vision (40 cm and 70 cm).

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Figure 1. Clinical retroillumination images of (*top*) superotemporal position in a right eye and (*bottom*) inferonasal position in a left eye of the near segment of rotationally asymmetric multifocal IOLs in the eye.

Patients were examined within 3 months postoperatively. A full ophthalmologic examination was performed as it was preoperatively with the main postoperative measurements, including binocular UDVA, UIVA, and UNVA. The binocular assessment was especially important in determining the performance of the combination of differing multifocal IOLs opposed to individual eyes.

A quality of vision (QoV) questionnaire was also completed postoperatively using a previously validated questionnaire.[12] This assessed how bothered the patients were by the questioned symptoms and how often they required reading spectacles. For symptoms, the patients responded either not at all (0), a little (1), quite (2), or very (3). When asked about reading spectacles, the patients responded never (0), occasionally (1), quite often (2), or always (3). The previously developed QoV questionnaire uses a Rasch-tested linear scale; however, a Rasch conversion was not necessary in this case to define differences between each item. Instead, this study used standard categorical analysis techniques to determine statistical differences between each item between groups. In this way, fidelity of the quantitative data retained for each item rather than losing specificity via a Rasch conversion. In addition, a linear 0 to 10 scale was used to define each patient's subjective view of total quality of vision to gain a better understanding of his or her postoperative satisfaction.

Intraocular Lenses

The Lentis Mplus is a foldable biconvex 1-piece multifocal acrylic IOL. It has a refractive design and is rotationally asymmetric, containing an aspheric distance vision zone and a sector-shaped near vision segment to allow good transition between the zones. Light is reflected away from the optical axis when light hits the transition zone of the embedded segment, preventing superposition of interference or diffraction. This IOL is available in +1.50 D, +2.00 D, and +3.00 D adds. In this study, patients in Group 2 received a +3.00 D add (Lentis Mplus LS-312 MF30 IOL) and the patients in Group 3 received a +2.00 D add (Lentis Mplus LS-312 MF20) with the near add in the superotemporal position in the dominant eye.

The Lenstec SBL-3 is a biaspheric asymmetric refractive multifocal IOL. It is acrylic, contains a distance section combined with a near vision segment (+3.00 D) in the anterior optic separated by a small wedge-shaped transition zone, and has a neutral aberration profile, as described by Venter et al.[6] All SBL-3 IOLs were placed with the near segment in the inferonasal position.

Surgical Technique

All surgeries were performed by the same experienced surgeon (J.E.M) with standard on-axis clear corneal phacoemulsification surgery. In all cases, the surgery was performed using sub-Tenon or topical anesthesia. A 2.75 mm incision was used to minimize residual corneal astigmatism, and the incision was placed on the steepest meridian to prevent the introduction of oblique astigmatism. Implantation of the multifocal IOL in the capsular bag was performed after a 5.0 mm anterior capsulorhexis was created. The refractive aim was emmetropia.

Statistical Analysis

Statistical analysis was performed using SPSS for Windows software (version 22, SPSS, Inc.) and Excel software (Microsoft Corp.). The Kolmogorov-Smirnov test was used to assess normality. For assessing continuous normal data, 1-way analysis of variance (ANOVA) with Tukey post hoc comparison was used. For assessing nonparametric data, the Kruskal-Wallis and Mann-Whitney *U* tests were applied. Following the methods outlined by Goodall et al.,[13] calculations showed that for this study to have 90% statistical power, the sample size required was more than 47 patients per group. The standard deviation of the QoV score was determined to be 0.90, and a clinically significant difference in QoV was determined to be 0.6. For all statistical analysis, the level of significance was a P value less than 0.05.

RESULTS

Demographics

Table 1 shows the preoperative parameters in the 3 groups of patients. Each group comprised 60 patients (120 eyes).

Overall Satisfaction and Spectacle Independence

Figure 2 shows the overall QoV scores for which QoV was rated from 0 to 10, with 0, the worst and 10, the best. Group 3 displayed significantly better QoV scores than Group 1 ($P = .001$, ANOVA) and Group 2 ($P = .002$, ANOVA). There was no significant

Table 1. Between-group comparison of preoperative patient data.

Parameter	Group 1	Group 2	Group 3	*P* Value
Sex, n (%)				—
Male	16 (27)	28 (47)	18 (30)	
Female	44 (73)	32 (53)	42 (70)	
Age (y)				
Mean ± SD	59.43 ± 8.14	63.50 ± 9.30	58.65 ± 6.23	.002
Median	60	66	56	
Range	47, 73	51, 88	46, 70	
Sphere (D)				
Mean ± SD	1.31 ± 3.11	0.75 ± 5.12	0.50 ± 3.59	.285
Median	1.50	2.00	1.50	
Range	−10.75, 8.75	−16.50, 8.00	−10.75, 6.50	
Cylinder (D)				
Mean ± SD	−0.54 ± 0.53	−0.75 ± 0.61	−0.52 ± 0.46	.002
Median	−0.50	−0.75	−0.50	
Range	−2.25, 0.00	−2.50, 0	−2.00, 0.00	
CDVA (logMAR)				
Mean ± SD	−0.05 ± 0.12	−0.02 ± 0.10	−0.03 ± 0.11	.261
Median	−0.10	0.00	−0.10	
Range	−0.20, 0.32	−0.20, 0.30	−0.10, 0.30	

CDVA = corrected distance visual acuity

difference between Group 1 and Group 2 combined compared with Group 3.

Figure 3 shows the percentage frequency of responses to spectacle independence for Group 1 and Group 2 (combined) and Group 3. Ninety percent (108 of 120 patients) of Group 1 and Group 2 (combined) said they never wore spectacles or only required reading spectacles occasionally, which was comparable to results in Group 3 in which 93% (51 of 60 patients) said they never or occasionally needed reading spectacles.

Visual Disturbances and Photopic Phenomena

Table 2 shows the individual symptom responses found in each group. Group 3 had lower mean scores for each questioned symptom, except double vision. Group 3 was significantly less affected by blurred vision than Group 1 ($P = .005$, Mann-Whitney U test).

Visual Acuity and Refraction

Table 3 shows the objective visual outcomes. There were no significant differences in binocular visual

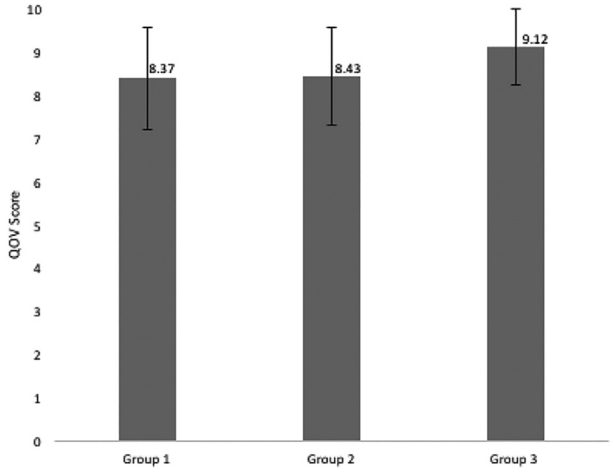


Figure 2. The mean overall QoV scores in the 3 groups within 3 months postoperatively. The QoV was rated out of 10, with 0 being the worst and 10 being the best (QoV = quality of vision).

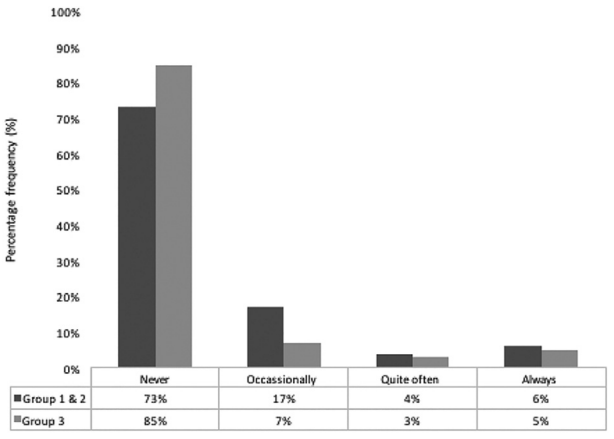


Figure 3. Patient response to how often they wear reading spectacles. The percentage of responses within 3 months postoperatively in Group 1 and Group 2 combined and Group 3 are shown in the histogram.

Table 2. Between-group comparison of subjective responses 3 months postoperatively.

QoV Question*	Mean ± SD			*P* Value
	Group 1	Group 2	Group 3	
How much does glare bother you?	0.58 ± 0.85	0.50 ± 0.72	0.30 ± 0.65	.78
How much do the halos bother you?	0.43 ± 0.85	0.43 ± 0.72	0.17 ± 0.42	.557
How much do the starbursts bother you?	0.63 ± 0.90	0.75 ± 0.86	0.25 ± 0.60	.286
How much does hazy vision bother you?	0.38 ± 0.69	0.33 ± 0.57	0.13 ± 0.43	.835
How much does blurred vision bother you?	0.58 ± 0.83	0.27 ± 0.52	0.23 ± 0.53	.023
How much does distortion bother you?	0.05 ± 0.39	0.10 ± 0.35	0	.253
How much do double images bother you?	0.08 ± 0.33	0.20 ± 0.55	0.22 ± 0.58	.211

QoV = quality of vision
*Grading scale: 0 = not at all; 1 = a little; 2 = quite; 3 = very

acuity measures between the groups. Figure 4 shows the cumulative binocular UDVA, UIVA, and UNVA in each group. Figure 5 shows the safety in each group.

There was no statistically significant difference in refractive sphere or the spherical equivalent (SE) between the groups; however, there was a statistically significant difference between the groups in postoperative refractive cylinder. Figure 6 shows the accuracy of the attempted SE correction in the 3 groups. Ninety-eight eyes (81.67%), 103 eyes (85.83%), and 103 eyes (85.83%) achieved within ±0.50 D of emmetropia, and 119 eyes (99.17%), 119 eyes (99.17%), and 118 eyes (98.33%) achieved within ±1.00 D in Group 1, Group 2, and Group 3, respectively.

DISCUSSION

Asymmetric multifocal IOLs have improved the objective and subjective postoperative outcomes after IOL-based surgery.[2,4,5,14,15] Because of the way the modern asymmetric multifocal IOL is designed, the position of the near segment and the power of the reading add can now be varied. These factors should be considered before multifocal IOL implantation; however, they have not been fully evaluated and might have an important influence on further enhancing postoperative patient satisfaction.

The manufacturers' guidelines indicate that the near segment of both rotationally asymmetric multifocal IOLs should be placed inferiorly with slight nasal deviation. An extensive study by Venter et al.[14] with the near segment in the recommended inferonasal position found excellent postoperative visual performance with the Lentis Mplus multifocal IOL. However, incidental rotation of the near segment has been found to be well tolerated, leading de Wit et al.[7] to evaluate this further. In their study, they found no significant difference in objective or subjective postoperative outcomes between inferonasal placement and superotemporal placement, confirming that superotemporal placement is well tolerated and the outcomes are similar to those of the inferonasal placement recommended by the manufacturers.

However, our anecdotal evidence led us to evaluate this further. Our clinical experience showed us that superotemporal placement reduces dysphotopsias. A case report by Pazo et al.[16] found that the superotemporal position of the near segment seems to increase the surface area of the distance zone exposed within the pupil, improving objective and subjective outcomes when placed this way in the dominant eye. The importance of this is evident when a patient enters an environment with bright lights; the good distance vision is retained despite pupil constriction because of the prevention of induced myopia, which can occur if too much of the near segment is in the pupillary region.

Another important consideration is the power of the reading segment selected. A study by McAlinden and Moore[9] found that asymmetric multifocal IOL implantation with a lower powered +1.50 D near add in the dominant eye in conjunction with a +3.00 D near add in the nondominant eye provided a range of good binocular vision. The dominant eye had excellent distance and intermediate vision, and the fellow eye had excellent distance and near vision. Therefore, in this study, an asymmetric multifocal IOL with a lower powered near add (+2.00 D) was implanted with superotemporal placement in the dominant eye to reduce dysphotopic side effects and optimize distance visual acuity, in combination with a +3.00 D add placed inferonasally in the fellow nondominant eye.

The purpose of this study was to determine the effect on objective and subjective outcomes of this combined placement of near segments in comparison with

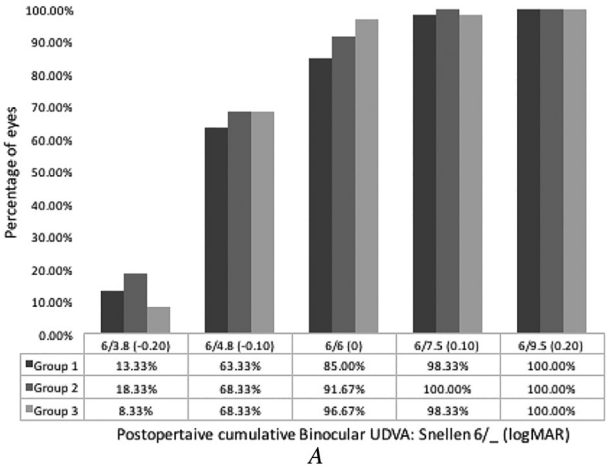
Table 3. Between-group comparison of visual and refractive outcomes 3 months postoperatively.

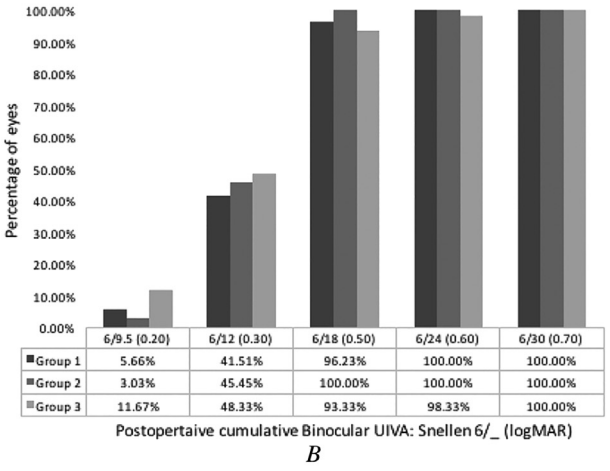
Parameter	Group 1	Group 2	Group 3	*P* Value
Binocular UDVA (logMAR)				
Mean ± SD	−0.05 ± 0.10	−0.08 ± 0.08	−0.07 ± 0.07	.195
Median	−0.08	−0.10	−0.1	
Range	−0.20, 0.20	−0.22, 0.10	−0.20, 0.24	
Sphere (D)				
Mean ± SD	0.14 ± 0.47	0.07 ± 0.37	0.20 ± 0.44	.056
Median	0.00	0.00	0.13	
Range	−1.25, 1.25	−0.75, 1.25	−1.25, 1.75	
Cylinder (D)				
Mean ± SD	−0.33 ± 0.40	−0.23 ± 0.35	−0.36 ± 0.34	.014
Median	−0.25	0.00	−0.25	
Range	−1.50, 0	−1.50, 0	−1.50, 0	
SE (D)				
Mean ± SD	−0.03 ± 0.47	−0.05 ± 0.41	0.02 ± 0.43	.457
Median	0.00	0.00	0.00	
Range	−1.63, 1.00	−1.13, 1.00	−1.63, 1.63	
Binocular CDVA (logMAR)				
Mean ± SD	−0.11 ± 0.07	−0.10 ± 0.07	−0.09 ± 0.06	.525
Median	−0.10	−0.10	−0.10	
Range	−0.20, 0.10	−0.22, 0.10	−0.20, 0.20	
Binocular UNVA (logMAR)				
Mean ± SD	0.10 ± 0.14	0.11 ± 0.11	0.12 ± 0.11	.622
Median	0.10	0.10	0.10	
Range	−0.20, 0.50	−0.10, 0.40	0.00, 0.40	
Binocular UIVA (logMAR)				
Mean ± SD	0.38 ± 0.10	0.36 ± 0.07	0.38 ± 0.12	.742
Median	0.40	0.40	0.40	
Range	0.20, 0.60	0.20, 0.50	0.20, 0.70	
Binocular DCNVA (logMAR)				
Mean ± SD	0.11 ± 0.18	0.11 ± 0.10	0.13 ± 0.13	.721
Median	0	0.10	0.10	
Range	−0.10, 0.60	−0.10, 0.30	0.00, 0.50	
Binocular DCIVA (logMAR)				
Mean ± SD	0.31 ± 0.12	0.35 ± 0.07	0.34 ± 0.10	.275
Median	0.30	0.35	0.30	
Range	−0.10, 0.50	0.20, 0.50	0.20, 0.60	

CDVA = corrected distance visual acuity; DCIVA = distance-corrected intermediate visual acuity; DCNVA = distance-corrected near visual acuity; SE = spherical equivalent; UDVA = uncorrected distance visual acuity; UIVA = unaided intermediate visual acuity; UNVA = uncorrected near visual acuity

bilateral inferonasal placement as advised by the manufacturers. To our knowledge, this is the first study to assess the objective and subjective postoperative outcomes of asymmetric multifocal IOLs positioned in this manner. This study provides surgeons with information regarding the placement of asymmetric multifocal IOLs as a way to improve postoperative patient satisfaction.

In our study, Group 1 and Group 2 had excellent overall QoV scores. There was no difference in mean scores between the groups. This is similar to a study of bilateral implantation of asymmetric multifocal IOLs with inferior placement of the near segment[17] in which patients were asked to rate their overall satisfaction postoperatively from 0 (least satisfied) to 10 (most satisfied). In that study, 78.1% of patients scored 8 or higher. Another study by Venter et al.[6] in which bilateral SBL-3 IOLs were implanted inferonasally found that 75% of patients were very satisfied with the outcomes. However, in our study, Group 3 had a significantly better mean overall QoV score (8.93 ± 0.94 [SD]) than Group 1 ($P = .001$, ANOVA) and Group 2 ($P = .002$, ANOVA) despite no statistical difference in objective UDVA. This shows that patients with a





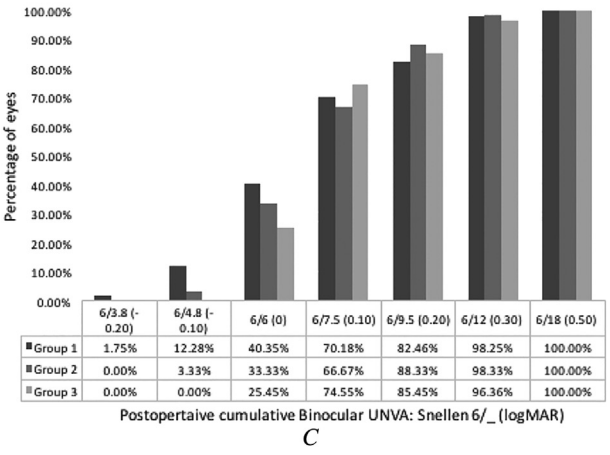


Figure 4. Cumulative binocular uncorrected (*A*) distance, (*B*) intermediate, and (*C*) near visual acuity in the 3 groups 3 months postoperatively (UDVA = uncorrected distance visual acuity; UIVA = uncorrected intermediate visual acuity; UNVA = uncorrected near visual acuity).

combination of superotemporal near segment (+2.00 D) and an inferonasal near segment (+3.00 D) in the fellow eye seem to be significantly more content with their quality of vision within 3 months postoperatively.

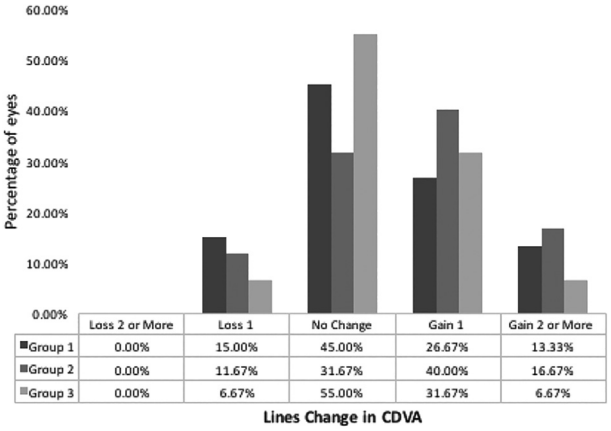


Figure 5. Safety comparison of preoperative CDVA and postoperative binocular CDVA in the 3 groups 3 months postoperatively (CDVA = corrected distance visual acuity).

All groups reported a low incidence of negative side effects. However, Group 3 was less affected by each of the questioned symptoms, except double vision, and Group 3 was significantly less affected by blurred vision than Group 1; there was no statistically significant difference in blurred vision between Group 2 and Group 3.

In addition, the level of safety was high in all groups, with no patient losing 2 or more lines of CDVA. Also, accuracy of the intended SE correction was excellent in all groups. There were no significant differences between the 3 groups in binocular UDVA, UIVA, and UNVA within 3 months postoperatively; however, there was a significant difference between the overall quality of vision. Therefore, this study suggests that the benefits of superotemporal

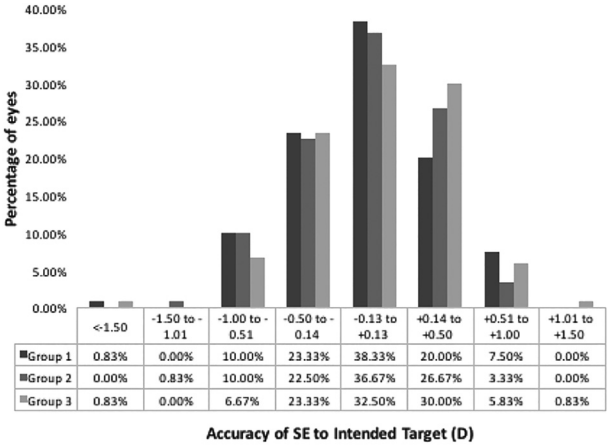


Figure 6. The accuracy of the intended SE refraction in the 3 groups 3 months postoperatively (SE = spherical equivalent).

placement of the near segment (+2.00 D) in the dominant eye improves the subjective perception of quality of vision and an individual still maintains adequate near and intermediate vision through inferonasal placement of a +3.00 D add asymmetric multifocal IOL. There was a statistically significant difference in postoperative cylinder between the groups; however, it was not clinically relevant. To confirm this, we excluded patients with a postoperative cylinder of more than 0.50 D in each group and reassessed the overall quality of vision between the groups. The combined superotemporal and inferonasal placement still yielded a statistically significantly higher overall QoV score.

Further analysis of this combination of asymmetric multifocal IOLs is required in a study with longer postoperative follow-up to determine how neuroadaptation affects subjective and objective outcomes and whether the superotemporal and inferonasal placement of asymmetric multifocal IOLs still results in better quality of vision over longer postoperative follow-ups.

One limitation of this study is that all of the different IOL combinations were not assessed (eg, another group with a +2.00 D near add positioned inferonasally in the dominant eye in combination with inferonasal placement of a +3.00 D near add in the fellow eye). McAlinden and Moore[9] assessed the use of a +1.50 D add inferonasally in the dominant eye. Therefore, future studies will assess the effect of other combinations of asymmetric multifocal IOLs on the objective and subjective outcomes to provide surgeons with more complete information on the best combination of IOL position and power. However, this study did find that the combination of superotemporal placement (+2.00 D) in the dominant eye and inferonasal placement (+3.00 D) in the nondominant eye provided binocular uncorrected visual acuity similar to that achieved with bilateral inferonasal placement, which was recommended by the manufacturers. In addition, the better level of quality of vision, despite no statistically significant difference between the groups in objective visual outcomes, suggests that this combination of asymmetric multifocal IOLs might enhance a patient's acceptance of the postoperative outcomes.

In conclusion, this study found that superotemporal placement of the near segment of a lower add (+2.00 D) asymmetric multifocal IOL in the dominant eye combined with a higher add (+3.00 D) and inferonasal near segment placement in the nondominant eye provided excellent overall quality of vision without affecting objective visual performance.

WHAT WAS KNOWN

- Asymmetric multifocal IOLs provide a good range of clear vision with focal dysphotopsias for which the perceived position within the visual field can be modified by the position of the near add.
- The position and power of the reading segment are important considerations; however, at present, there is no consensus on the best IOL placement or power to use.
- In general, manufacturers advise bilateral inferior near placement with slight nasal deviation and choice of +1.50 D, +2.00 D, or +3.00 D near adds.

WHAT THIS PAPER ADDS

- Positioning the near add of asymmetric multifocal IOLs differently between the 2 eyes in the form of superotemporal placement (+2.00 D add) in the dominant eye and inferonasal position (+3.00 D add) in the nondominant eye provided better binocular quality of vision. The asymmetric placement reduced the likelihood of distance or near add loss in cases with significant pupil centroid shift.

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