

Refractive Segmental Versus Diffractive Multifocal Optic Designs

A closer look at the literature and personal results.

BY KYUN-HYUNG KIM, MD, PHD



With an increasing number of available premium IOL options, it is important for surgeons to understand the nuances of IOL design and to make an informed recommendation for patients so that they may achieve their expected outcomes. One way to achieve these goals is with multifocal IOLs.

DIFFRACTIVE VERSUS REFRACTIVE VERSUS TRIFOCAL IOLS

Multifocality is achieved through a refractive or a diffractive optical approach. With diffractive multifocal IOLs, which incorporate concentric annular rings, diffraction is intentionally induced into the optical system so that the light waves exiting the lens interfere constructively at two or more foci at different distances. With refractive multifocal IOLs, which incorporate a zonal design, the light waves exit the lens from different annular regions and are shaped so that they converge also to two or more foci. Lastly, trifocal IOLs are available that use diffractive optical approaches.

Multifocal IOLs with a rotationally asymmetric design, such as the LENTIS IOL family (Teleon Surgical), incorporate two segments, an aspheric distance vision zone and a +1.50 D sector-shaped near vision zone, that are blended to create an extended depth of focus (EDOF). This IOL design provides a smooth transition from distance to near, and the reduced add power increases intermediate visual acuity and decreases optical phenomena such as glare and halos.

The most forgiving type of IOL is a monofocal lens. After successful cataract surgery, these IOLs provide a high degree of tolerance, and patient selection is therefore very straightforward. Refractive multifocal IOLs, especially those with a refractive segmental design, also provide a high degree of forgiveness compared to diffractive multifocal IOLs. Patient counseling is also relatively straightforward with the LENTIS Comfort IOL because, in my experience, it is the next most forgiving IOL available today.

PERSONAL EXPERIENCE

I have implanted the LENTIS Comfort in about 500 patients to date. Preoperatively, I counsel patients that their intermediate and distance vision will be exceptional—in my experience J1 or J2 intermediate—and that they may need spectacle correction for near visual tasks.

I believe that the IOL provides the best results among the available low-add EDOF IOLs. Patients are extremely pleased with their postoperative results, and I have not had to explain a single

lens. Further, patients do not complain of visual disturbances including halos and glare.

I also have experience with the AcrySof IQ Vivity (Alcon), another refractive multifocal IOL design, and the Tecnis Symphony (Johnson & Johnson Vision), a diffractive multifocal IOL. To date, I have implanted about 20 Vivity IOLs and 100 Symphony IOLs. In my early experience, the Vivity provided good visual acuity. Patients, however, were more likely to complain of halos and glare postoperatively compared to patients who received the LENTIS Comfort. Likewise, in my experience with the Symphony, patient tolerance was not as strong as it is with the LENTIS Comfort.

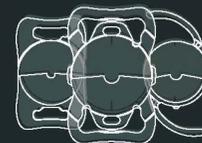
Contrast sensitivity, in my experience, is also the highest with the LENTIS Comfort IOL compared to these other IOLs. Patients in my practice who have received a diffractive IOL sometimes complain that their visual quality in dim light is poor. With the LENTIS Comfort, however, contrast sensitivity in low-light conditions, both indoors and at nighttime, is good. This is advantageous for many patients, including the elderly and those with high myopia, mild glaucoma, macular pathologies, and a history of refractive surgery.

For all these reasons, I use the LENTIS Comfort in a wide range of patients. Simply stated, it has high forgiveness and excellent postoperative visual acuity. I usually recommend the Comfort IOL to patients who enjoy driving, including those who drive at night, and those who value their intermediate vision over near vision.

I like to underpromise and overdeliver. Therefore, I counsel patients that they may need reading glasses. Only about 50% of my Comfort patients, however, will need reading glasses at some point.

COMPARABLE RESULTS

My personal results compare favorably to a recent study that compared the visual outcomes and optical quality with two presbyopia-correcting IOLs and one monofocal IOL. In this single-center, prospective, nonrandomized, participant- and examiner-blinded cohort study, Song and colleagues compared the distance, intermediate, and near visual acuities; defocus curve; contrast sensitivity; wavefront aberrations; and modulation transfer function (MTF) with the EDOF Tecnis Symphony ZXR00, the zonal refractive multifocal LENTIS Comfort LS-313 MF15, and the monofocal LENTIS Comfort L-313 IOLs.¹ Postoperative examinations were performed at 1 week, 1 month, and 3 months. Patients also completed two questionnaires, the Visual Function Index (VF-14) and the Quality of Vision (QoV), and a self-evaluation of their visual quality.



Figures and table adapted from: Song X, Liu X, Wang W, et al. Visual outcome and optical quality after implantation of zonal refractive multifocal and extended range-of-vision IOLs: a prospective comparison. *J Cataract Refract Surg.* 2020;46:540-548.

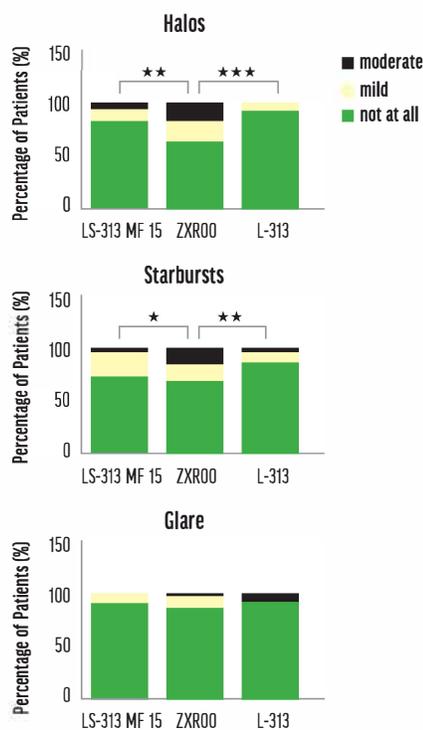


Figure 1. Severity of halo (top), starbursts (center), and glare (bottom). * $P < .05$; ** $P < .01$; *** $P < .001$.

A total of 113 patients (age range, 50–85 years) who underwent cataract surgery were enrolled in the study. The range of intermediate vergence ($P < .05$) and distance-corrected intermediate visual acuity ($P \leq .001$) were significantly better with the LENTIS Comfort LS-313 MF15 and the Tecnis Symphony IOLs compared with the monofocal LENTIS Comfort. The two presbyopia-correcting IOLs also provided higher VF-14 ($P < .05$) and visual quality self-evaluation ($P < .05$) scores. There was no difference in score between these two IOLs, however (Table).

The total wavefront aberrations were lowest and the MTF the highest with the EDOF IOLs, but the QoV score was the lowest, especially for the severity of halos ($P < .01$) and starbursts ($P < .05$) (Figure 1). The investigators concluded that, in their study, both the Symphony and LENTIS Comfort LS-313 MF15 provided excellent and stable distance and intermediate visual acuity, good subjective visual function,

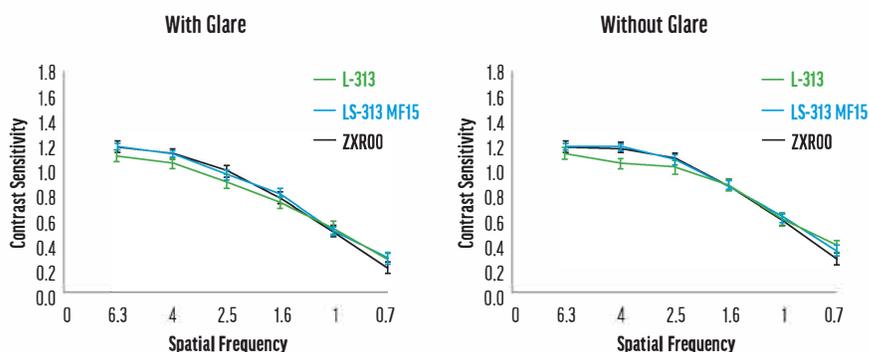


Figure 2. Contrast sensitivities with (left) and without (right) glare under mesopic conditions 3 months after IOL implantation.

TABLE. SUBJECTIVE EVALUATION BY QUESTIONNAIRES 3 MONTHS AFTER IOL IMPLANTATION					
Parameter	L-313	LS-313 MF15	ZXROO	Comparison	P Value
VF-14 score > 90 (%)	48.9	78.7	61.7	LS vs L-313 ZXROO vs L-313 LS vs ZXROO	.012* .005* .3 .114
Visual quality self-evaluation (mean ± SD)					
Day score	8.68 ± 1.03	8.98 ± 1.26	9.19 ± 1.25	LS vs L-313 ZXROO vs L-313 LS vs ZXROO	.029* .220 .028* 1
Night score	8.36 ± 1.16	8.90 ± 1.37	8.66 ± 1.43	LS vs L-313 ZXROO vs L-313 LS vs ZXROO	.027* .023* .318 .877
QoV score (mean ± SD)	1.83 ± 3.03	3.98 ± 6.99	5.66 ± 6.06	LS vs L-313 ZXROO vs L-313 LS vs ZXROO	0 .81 .01* .034*

Abbreviations: IOL, intraocular lens; QoV, quality of vision; VF-14, Visual Function Index questionnaire; SD, standard deviation
* $P < .05$, ** $P < .01$, *** $P < .001$.

and good contrast sensitivity (Figure 2). Dysphotopsias were most prominent with the Tecnis Symphony EDOF IOL.

CONCLUSION

In today's competitive premium IOL market, the LENTIS Comfort is one of the most versatile and forgiving lens designs. In my experience, patients are happy with their vision, and there is a low rate of visual disturbances including halos and glare. Compared to IOLs with a

diffractive design, as well as to others with a refractive design, the LENTIS Comfort is more forgiving. This bolsters a high rate of satisfaction for a wide range of patients. ■

1. Song X, Liu X, Wang W, et al. Visual outcome and optical quality after implantation of zonal refractive multifocal and extended-range-of-vision IOLs: a prospective comparison. *J Cataract Refract Surg.* 2020;46:540-548.

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