Reply to comment on: Distinct differences in anterior chamber configuration and peripheral aberrations in negative dysphotop

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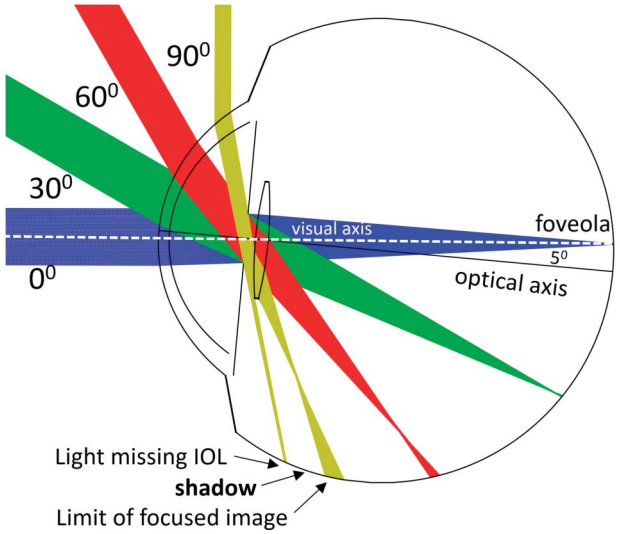

Figure 1. Average right eye from above for input visual angles of 0, 30, 60, and 90 degrees, with thin iris and 2.5 mm actual pupil diameter.[2] The main focused image reaches a limit and goes dark due to vignetting at about 90 degrees, yet the phakic eye is believed to image to 105 degrees. Light at about 90 degrees illuminates 2 different retinal regions.

previously been measured.[3,5] Different lens styles are also often all evaluated together, even though there are distinctive differences in the peripheral regions of IOLs that might perhaps contribute to different peripheral phenomena.[3] Conventional perimetry has particular limitations for these measurements anyway, because the pupil diameter is neither controlled nor measured, and the perimetry bowl only extends to 90 degrees, even though measurements are needed at larger angles to reach the limit of the visual field. Figure 1 illustrates ray paths for an average eye, and although the actual perceived shadow angle is difficult to calculate using a model because the ocular data for the far periphery are very limited, with the type of negative dysphotopsia that is related to vignetting at the IOL, it is very unlikely to be as low as 60 or 70 degrees.

The article by van Vught et al. adds important information to the discussion of negative dysphotopsia. In addition, the iris tilt of about 5 degrees seems to be related to the angle between the visual and optical axes, which is often called angle α (with angle κ describing iris centration). This type of terminology is not always unique, however, and the use of a rotationally symmetric model eye highlights this particular characteristic.

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Disclosures: *None reported.*

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We thank the correspondent for the thoughtful consideration of our work and for the acknowledgement that it adds a new perspective for negative dysphotopsia research.[1] The presented in vivo data indeed confirm some of the observations proposed in earlier theoretical ray-tracing analyses on the cause of negative dysphotopsia, such as the smaller pupil size.[1–3] For a better understanding of the fundamental cause of negative dysphotopsia, we believe that additional, more patient-specific, analyses are needed because the relevance of these factors for individual patients still has to be determined. These factors include, for instance, the complete IOL design and the retinal shape. Such patient-specific analyses could link the clinical observations, such as visual field eccentricities at which shadowlike effects occur, with the powerful ray-tracing methods proposed in the more theoretical studies.[2–4]

Personalizing these analyses will, however, require a highly personalized eye model. Such a patient-specific eye model would, for example, include the actual shape and location of the IOL and a personalized retinal shape because they both affect the location at which the shadow is perceived. However, the design of these personalized models requires additional imaging data, such as magnetic resonance imaging, to quantify, for example, the retinal shape.[5] The additional benefit of such a personalized model is that it will circumvent the ambiguity in the terminology of the angles between different axes because all elements of the eye will be modeled at their exact position. More importantly, these patient-specific ray-tracing analyses can hopefully confirm the theoretical observed causes of negative dysphotopsia, aiding to design a definite method to prevent or treat this bothersome condition.

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Comment on: Comparison of clinical outcomes between vector planning and manifest refraction planning in small-incision lenticule extraction for myopic astigmatism

Jun et al. should be congratulated on their important study comparing clinical outcomes between vector planning (VP) and conventional manifest refraction (MR) for the treatment of myopic astigmatism with small-incision lenticule extraction (SMILE).[1,2] The findings of this groundbreaking study demonstrated statistically significant better outcomes for the VP-treated patients for both refractive cylinder and corneal astigmatism as well as internal aberrations as quantified by ocular residual astigmatism (ORA) than those treated by conventional MR. Angle of error, correction index (CI), and linearity of slope of line of best fit between surgically induced astigmatism vector and target-induced astigmatism vector were also significantly better.

With such clear-cut superiority of the VP group, it is difficult to rationalize such a problematic conclusion recommending a requirement for a nomogram adjustment. A nomogram adjustment means that this Zeiss SMILE device is systematically over or under correcting astigmatism across ALL treatments—which is incorrect according to the results in this study in which the overall CI is very close to the ideal 1.0. The authors suggest a nomogram adjustment for the cylinder treatment of the MR group alone. If a nomogram adjustment was to be applied to the MR group, which has a CI of 0.88 by refraction, then the overcorrection by corneal values of 1.24 (arithmetic mean of 1.06 for both CI) would be further increased to cause adverse corneal outcomes for the MR group. When extended to the VP group, this would also adversely affect the excellent outcomes achieved, with the CIs of both refractive (1.04) and corneal (0.98) analyses (arithmetic mean 1.01) being optimal.

Just as treatment is shown to have benefit by an ideal balance between corneal and refractive astigmatism parameters, so too does the analysis postoperatively of nomogram adjustments benefit by both being taken into account as performed below.

CI analysis: (1) corneal measurements (from Table 3) MR 1.24 VP 0.98 (2) refractive measurements (from Supp. Table 2 calculated for zero target) MR 0.88 VP 1.04.

The statistically significant difference between MR and VP is not due to any nomogram adjustment being required, but rather the VP method of incorporating both corneal and refractive astigmatism parameters into the treatment profile, leading to beneficially reduced astigmatism, cylinder, and internal aberration outcomes.

Furthermore, the stated solution to resolve differences that exist between corneal and refractive values by repeating the MR with more care or accuracy belies the fact that care was likely taken with the first test and a significant proportion of eyes will still have ORAs greater than 0.75 diopters after retesting.

This study reconfirms the findings by Arbelaez et al. in demonstrating better outcomes for VP with less corneal astigmatism remaining postoperatively, compared with treatment using MR parameters.[3] This important benefit was achieved without compromising refractive cylinder outcomes. However, it seems the authors here may have misinterpreted the astigmatism analyses of their own study in suggesting a nomogram adjustment would provide benefit when in fact from their own published figures, as tabulated above, the Zeiss SMILE device without any correction adjustments is performing excellently by examining both corneal and refractive astigmatism parameter analyses.

With several studies now demonstrating the benefits of VP when treating astigmatism, consideration should be given to VP being adopted as the standard of care in refractive surgery for the treatment of myopic astigmatism.

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