

# Choosing Customized IOLs

How important is it to minimize spherical aberration after cataract surgery?

BY FARRELL C. TYSON II, MD

In order to optimize my patients' vision after cataract surgery, I use diagnostic information obtained by the Marco 3D Wave (Jacksonville, FL; also known as the Nidek OPD scan, Nidek Inc., Fremont CA). The device enables me to determine which IOLs will minimize patients' level of spherical aberration.

TABLE 1. OPTIMAL RANGE OF CORRECTION FOR ASPHERIC IOLs			
IOL Design	Degree of Spherical Aberration ( $\mu\text{m}$ )	Range of Marco 3D Wave Q Value ( $\mu\text{m}$ )	Range of Spherical Aberration ( $\mu\text{m}$ )
Standard monofocal	Positive aberration	$\leq -0.52$	$\leq -0.05$
Sofport AO	-2.50	-0.52 to -0.41	-0.5 to +9.50
Acrysof IQ	-12.50	-0.41 to -0.28	+9.50 to +22.00
Tecnis	-25.00	$\geq -0.28$	$\geq +22.00$

## ADDRESSING SPHERICAL ABERRATION

The designs of spherical IOLs and the methods for noncontact biometry have improved so much in recent years that we surgeons are achieving plano outcomes more frequently. Our next step is reducing spherical aberration.

In addition to performing wavefront analysis, the Marco 3D Wave combines autorefractometry, corneal topography, and pupillometry. It also provides a Q value, which measures the change in slope between the center and the periphery of the cornea.

Assuming the average corneal K is 43.86mm, the Q value indicates approximately how much spherical aberration is present in a patient's cornea before cataract surgery. Based on the Q value of each eye, I can choose a wavefront-enhanced IOL that will minimize each patient's preexisting corneal spherical aberration and bring his vision closest to net zero (Table 1).

## MATCHING Q VALUES AND IOLs

I use three different wavefront-enhanced IOLs in my practice: the Tecnis (Advanced Medical Optics, Inc., Santa Ana, CA); the Sofport AO (Bausch & Lomb, Rochester, NY); and the Acrysof IQ (Alcon Laboratories, Inc., Fort Worth, TX). Each of these IOLs has a different degree of spherical aberration:  $-25.00\mu\text{m}$  (Tecnis);  $-12.5\mu\text{m}$  (Acrysof IQ); and  $-2.50\mu\text{m}$  (Sofport AO).

Most of my patients are hyperopes, which means their Ks are steeper than average. Because positive

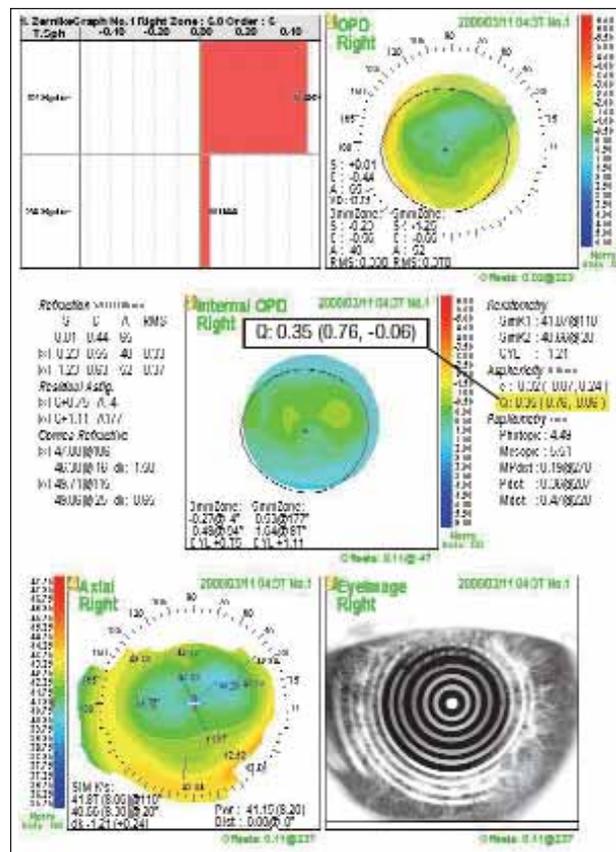


Figure 1. According to Dr. Tyson's system, the most appropriate IOL for reducing spherical aberration in this patient is the Tecnis IOL.

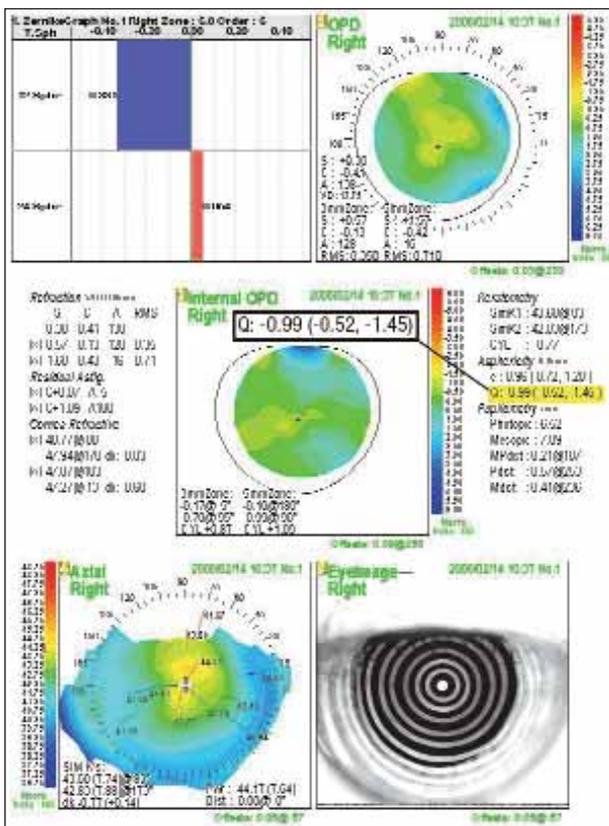


Figure 2. Dr. Tyson probably would implant standard monofocal IOLs in the eyes of this patient who underwent previous hyperopic LASIK.

spherical aberration increases with steeper Ks, I tend to underestimate my patients' total spherical aberration.

“The demand for wavefront-enhanced IOLs is likely to increase further, because patients who underwent refractive surgery ... are entering their cataract years.”

Nevertheless, I find that approximately 90% of my patients benefit from the Tecnis IOL, whereas the Acrysof IQ works best for eyes with mild positive spherical aberration. I reserve the Sofport AO for patients who have mild or no preoperative spherical aberration.

**CONCLUSION**

My patients appreciate my efforts to minimize their spherical aberration. The demand for wavefront-enhanced IOLs is likely to increase further, because patients who underwent refractive surgery before the availability of wavefront-guided technology are entering their cataract years. Moreover, myopic LASIK produces excessive spherical aberration (Figure 1), which traditional IOLs may exacerbate. In contrast, patients who had hyperopic LASIK may perform better with standard monofocal IOLs (Figure 2).

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**DISCUSSION**

By Mark Packer, MD, FACS

The concept of neutralizing preoperative spherical aberration presupposes a known postoperative target. Current evidence, including data from the FDA-monitored night-driving simulation study,<sup>1</sup> supports a target of  $Z_{4,0} = 0$ , or zero total spherical aberration. Spherical aberration and depth of focus tend to have an inverse relationship, however, and researchers have proposed different target values for total spherical aberration.<sup>2</sup>

Another important factor to consider when attempting to minimize spherical aberration after cataract surgery is the degree of spherical aberration induced by the actual procedure. In most cases, this amount is approximately  $\pm 0.03\mu\text{m}$ .<sup>3</sup> Surgeons performing small-incision phacoemulsification, particularly

“Others have proposed different target values for total spherical aberration.”

when using clear corneal temporal incisions smaller than 3mm, can feel confident that the degree of surgically induced spherical aberration is negligible.

**KERATOMETRY AND ZERNIKE**

Assuming a targeted postoperative degree of spherical aberration of zero and noting the availability of three different wavefront-enhanced IOLs, we can construct a selection chart based on preoperative corneal spherical aberration (Table 1). We must

**TABLE 1. SELECTION CHART FOR  
POSTOPERATIVE TARGET OF  $Z_{4,0} = 0$**

IOL Design	$Z_{4,0}$ ( $\mu\text{m}$ )
Spherical IOL	$\leq -0.085$
Sofport AO	-0.085 to +0.135
Acrysof IQ	+0.135 to +0.235
Tecnis	$\geq +0.235$

remember, however, that corneal spherical aberration is not equivalent to corneal eccentricity (the Q value) and that keratometry also contributes to spherical aberration.

According to an e-mail I received from Jack Holladay, MD, on May 22, 2006, the mean corneal values for the human population are  $K = 43.86\text{D}$ ,  $Q = -0.26\mu\text{m}$ , and spherical aberration =  $0.26\mu\text{m}$ . When K values exceed  $43.86\text{D}$ , spherical aberration increases only if the Q value remains constant.

An alternative to relying on Q values when choosing IOLs to minimize postoperative spherical aberration may be to calculate patients' Zernike coefficients with specially designed software. One such program is VOL-CT (formerly CTView; Sarver and Associates, Carbondale, IL).

### THE FUTURE

Further research will help elucidate to what extent customizing spherical aberration is beneficial for patients. Studies of contrast sensitivity and functional vision will form the foundation of our continued exploration of correcting higher-order aberration after cataract and refractive lens surgery. ■

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