Centration and Diffractive Multifocal IOLs

Centering these lenses on the pupil is crucial to their optimal performance.

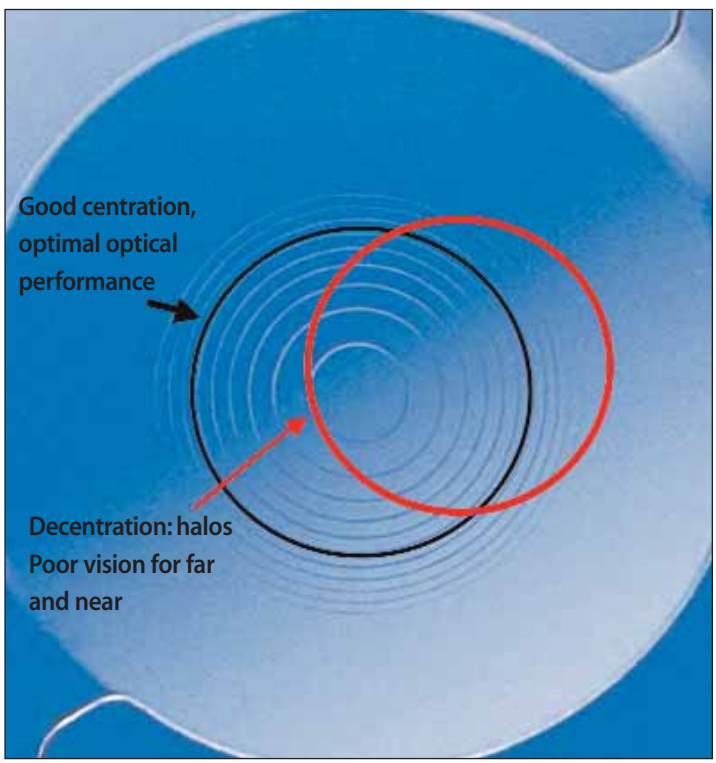
BY JACK T. HOLLADAY, MD, MSEE, FACS

The Acrysof Restor (Alcon Laboratories, Inc., Fort Worth, TX) and Tecnis Multifocal (Advanced Medical Optics, Inc., Santa Ana, CA; not FDA approved) IOLs both use diffractive optics, as do other multifocal lenses available internationally. It is crucial to center on the pupil (rather than the center of the bag) all IOLs using this optic design.

REFRACTIVE VERSUS DIFFRACTIVE OPTICS

Lenses such as the Rezoom (Advanced Medical Optics, Inc.) use aspheric refractive zones and all of the available light to create multifocality. The Rezoom lens in particular was designed to provide patients with vision at all distances, with a balance that slightly favors distance and intermediate vision.

Diffractive multifocal lenses use higher-order optics to create two focal points, one at distance and one at near. The Acrysof Restor lens provides approximately a 3.00D add (working distance of 33.00cm or 13.13 inches) at the spectacle plane. The design emphasizes distance and near and provides a lesser visual performance at intermediate distances. The Rezoom lens provides approximately 2.70D (working distance of 37.00cm or 14.58 inches). The design emphasizes distance and



(Courtesy of Paolo Vinciguerra, MD.)

Figure 1. Good centration of the IOL with respect to the pupil (black arrow and circle) optimizes the lens' performance. Decentration (red arrow and circle) results in halos and poor vision at far and near.

intermediate vision. Diffractive IOLs generally use 40% of the available light for distance and 40% for a second focal point. The remaining 20% is lost to destructive interference.

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The spacing and height of the rings that create the images for the bifocal IOLs determine the location of the focal points and the balance of light between them. Because tilting and decentration affect the rings' effective spacing and height to a much greater extent than refraction, the slight decentration or tilting of the IOL has a more significant effect on visual outcomes with diffractive versus refractive multifocal lenses. It is therefore imperative that the former be centered on the pupil.

CENTRATION

Paolo Vinciguerra, MD, first presented the issue of decentered diffractive multifocal IOLs in 2005.[1] He shared three cases of patients with these lenses whose visual performance was problematic due to the IOLs' decentration with respect to the pupil (Figures 1 and 2). In addition, he demonstrated simple techniques for recentering the lenses during the primary surgery and in the early postoperative period.

The Nidek OPD Scan (Nidek, Inc., Fremont, CA), unlike Hartmann-Shack or Tscherning wavefront analyzers, can measure the eye's wavefront optical performance using skiascopy reflexes, similar to retinoscopy. Using the Nidek OPD Scan, Dr. Vinciguerra could confirm the significant reduction in optical performance with a decentered diffractive multifocal lens and the subsequent improvement after the IOL's recentration on the pupil. In addition, he showed that the patients' visual acuity improved and their symptoms resolved. Marie Jose Tassignon of Antwerp, Belgium, also confirmed the problem with centration using the Tracey Wavefront System (Tracey Technologies, Houston, TX).[2]

(Courtesy of Paolo Vinciguerra, MD.)

Figure 2. The IOL's diffractive rings are perfectly concentric with the pupil.

TECHNIQUE

The slight decentration of an IOL with respect to the pupil is common, because the pupillary center is nasal to the optical center of the eye (the geometric center of the cornea, crystalline lens, and bag after nuclear and cortical removal). A lens placed and centered in the capsular bag will almost always be temporal to the center of the pupil (0.3mm on average).

Dr. Vinciguerra recommends that surgeons implanting diffractive multifocal IOLs place the haptics vertically at the 12- and 6-o'clock positions so that the lens can be slightly decentered nasally in the bag. Placing the haptics horizontally causes the IOL to return to the geometrically horizontal center. At the end of surgery, the lens optic will be slightly nasal in the bag when the diffractive rings are concentric with the pupil. Dr. Vinciguerra has shown that this technique eliminates problems with the lenses' optical performance. If he notes that the IOL is slightly decentered during the first postoperative week and the patient's visual performance is compromised, he will push the lens nasally to the center of the pupil while the patient is at the slit lamp.

CONCLUSION

Centering diffractive multifocal IOLs on the pupil is critical to their optimal performance. Although they are less sensitive to decentration, refractive multifocal IOLs should also be centered on the pupil, because severe cases of decentration can increase the lens' effective power and induce astigmatism and coma. ■

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1. Vinciguerra P, Epstein D. Correction of presbyopia in cataract surgery. Paper presented at: The Refractive On-Line Symposium; September 15, 2005; Milan, Italy.
2. Tassignon MJ. Centration of multifocal IOLs. Paper presented at: World Ophthalmology Congress; February 23, 2006; São Paulo, Brazil.