TOOLS FOR OPTIMIZING SURGICAL OUTCOMES

Analysis of results is key in the pursuit of patient satisfaction and refractive excellence.

BY PETER MOJZIS, MD, PHD, FEBO; AND HALUK TALU, MD

Advanced Diagnostics

By Peter Mojzis, MD, PhD, FEBO

Patient expectations for spectacle independence after cataract surgery are high, especially when multifocal IOLs are implanted. Postoperative emmetropia, long-term stability of refraction, a low rate of PCO, and absence of halos and glare are the main factors contributing to high satisfaction in these patients. Similar expectations are also present in patients undergoing toric multifocal IOL implantation for the treatment of corneal astigmatism greater than 1.00 D. Several tools have been developed to evaluate and monitor postoperative surgical results, heightening the surgeon's ability to deliver the optimal outcomes that patients demand.

POSTOPERATIVE DATA MANAGEMENT TOOLS

PCO measurement. To evaluate the severity and progression of PCO, I use the EPCO 2000, a software tool, developed by Manfred Tetz, MD, that provides a measure of PCO that is independent of visual impairment and is based exclusively on objective morphologic assessment of PCO. With the software, a high-resolution retroillumination image of the capsular bag is taken using a slit lamp connected to a camera. Areas with various densities of PCO are marked on the computer screen by the observer, and a numerical value (grade 0 to 4) is assigned to the density of the opacification according to the scale below.

EPCO calculates the individual PCO score for each eye by multiplying the density of the opacification by the fractional PCO area behind the IOL optic (Figure 1). EPCO calculates the density surface mathematically by performing pixel counts.

OPACIFICATION DENSITY SCALE

1. Minimum wrinkling of capsule with a fine layer of lens epithelial cells (LECs)
2. Mild honeycomb PCO, thicker layer of LECs with dense fibrosis
3. Classic Elschnig pearls, very thick layer of LECs
4. Severe opacity with a darkening effect

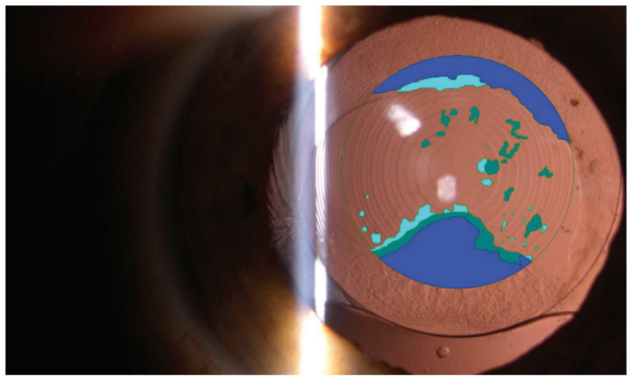

Figure 1. A patient implanted with the AT LISA tri 12 months postoperatively, showing EPCO evaluation of PCO density within a 4.3-mm central zone; areas with low PCO density are marked with lighter color and areas with higher PCO density with darker colors.

Halo and glare simulator. Patients implanted with multifocal IOLs often complain of photic phenomena, such as glare or halos. These phenomena result in a deterioration of visual acuity and a loss of contrast sensitivity, especially under mesopic and scotopic conditions. An objective measurement of these phenomena can be taken using halo and glare simulator software (Eyeland Design; Figure 2). Quantification is based on a subjective outline of the perceived dysphotopsia. This test is simple and fast, but its main limitation is reliability.

Toric IOL summary. Precise preoperative calculation, accurate intraocular alignment, long-term rotational stability, and IOL centration are crucial factors in ensuring optimal correction of preexisting corneal astigmatism with toric IOLs. To assess the alignment of toric IOLs, I use the Toric IOL Summary program available on the OPD Scan III (Nidek). First, a retroillumination image is taken under mydriasis. Then the program objectively compares the position of axis markers on the lens optic with the steep meridian orientation in order to assess IOL alignment in the capsular bag (Figure 3).

Pupil image summary. Angle kappa is the angular distance between the pupillary and visual axes. If the visual axis is separated significantly from the pupillary axis (high angle kappa), multifocal lens centration on the center of the pupil may lead to an increased perception of photic phenomena

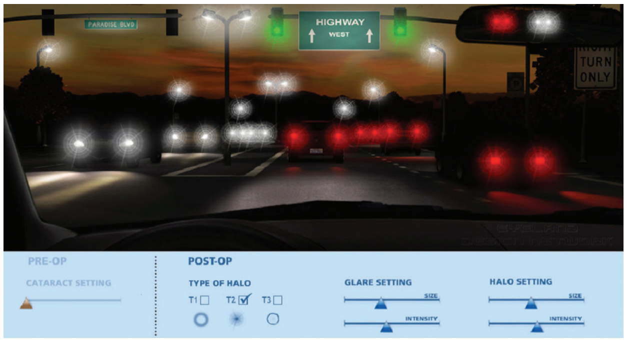

Figure 2. Halo and glare evaluation 3 months after AT LISA tri IOL implantation.

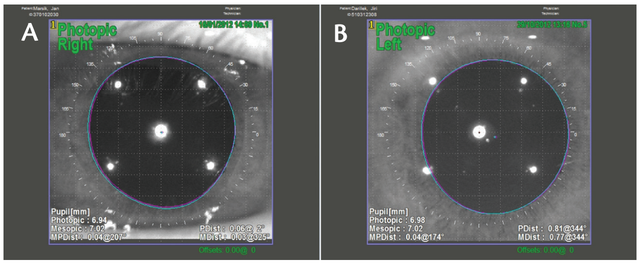

Figure 4. A patient with significant difference between the pupillary and visual axes (A) and a patient with low angle kappa, where pupillary and visual axes are coincident (B).

postoperatively. To prevent postoperative halos and glare, preoperative measurement of angle kappa is useful. The pupil image summary generated by the OPD Scan III is helpful in obtaining the correct position for lens centration (Figure 4).

ASSORT analysis. Vector analysis is a useful method for assessing the effectiveness of astigmatic correction. Based on the Alpins vector method, the ASSORT software (ASSORT Surgical Management Systems; www.assort.com) analyzes and reports the relationships between the vectors and parameters (for more on the Alpins method, see article on page 24.)

CONCLUSION

Many diagnostic tools are available to help surgeons assess and improve their postoperative refractive results (see *Outcomes Analysis Software*). The software programs and devices discussed above, as well as other innovations such as smartphone applications, will likely become standard methods for optimizing surgical outcomes in the future.

1. Mojzis P. AT LISA tri – challenging cases. Presented at: the XXXI ESCRS Congress; October 5-9, 2013; Amsterdam.
2. Mojzis P, Peña-García P, Liehneova I, Ziak P, Alió JL. Outcomes of a new diffractive trifocal intraocular lens. *J Cataract Refract Surg*. 2014;40:60-69.
3. Alpins N. Astigmatism analysis by the Alpins method. *J Cataract Refract Surg*. 2001;27(1):31-49.

Peter Mojzis, MD, PhD, FEBO
- Medical Director, Premium Clinic Teplice, Czech Republic
- Chief of the Eye Department, Regional Hospital, Havlickuv Brod, Czech Republic
- mojzispeter@hotmail.com
- Financial disclosure: Consultant, Speaker fees (Carl Zeiss Meditec)

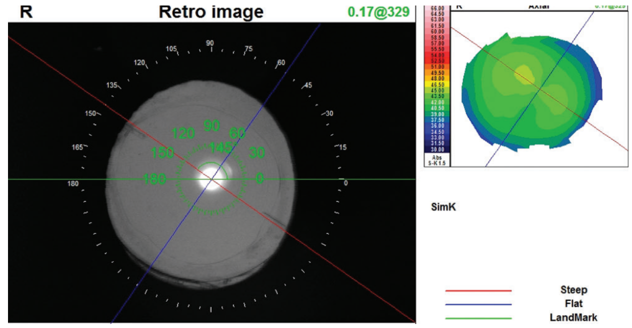

Figure 3. AT LISA tri toric 18 months after surgery; the axis markers at the edge of the IOL are parallel to the red line (steep meridian), indicating excellent IOL rotational stability.

In Pursuit of Refractive Excellence

By Haluk Talu, MD

I started to perform phacoemulsification and refractive surgery in 1994, so I have always had the ability to correct postphaco refractive errors with laser vision correction. However, being obliged to correct what you have already done is not a pleasant feeling for anyone. My monthly cataract surgery (n=100 eyes) and laser vision correction (n=200 eyes) volumes provide me with substantial data on my outcomes, allowing me to analyze how close I come to refractive perfection.

REFRACTIVE CATARACT SURGERY

Clear corneal incisions (CCIs). Fifteen years ago, Emanuel Rosen, MD, showed me how he managed astigmatism by using opposite CCIs. Once I switched to steep-axis CCIs and opposite CCIs, I began to feel like a refractive cataract surgeon. In earlier years, CCIs were around 3 mm in size, and an enlargement to 3.2 to 3.5 mm was required for IOL implantation. After the development of IOL injectors and cartridges, the original size of the CCI could be maintained, and I started to evaluate my induced astigmatic effect more accurately. It appears that the induced astigmatic effect decreases as the size of the CCI decreases.

I have never used any specific software or formula to assess my refractive outcomes. Generally, I follow patients on a refractive basis and have an understanding of how I am doing. At certain times, when I have many cases per day, I may decide to focus on the status of the astigmatic effect of CCIs, follow those cases in terms of refractive outcomes, and test my assumptions according to the refractive and keratometric results. On days when there is any major change in my equipment, I do not do these control tests. I implant at least one multifocal IOL every day, and I use these multifocal IOL patients, for whom refractive precision is paramount, as daily indicators of my surgically induced astigmatism.

Surgically induced astigmatism (SIA). For with-the-rule (WTR) corneal astigmatism, in my hands, a superior CCI performed with a 2.4-mm phaco slit knife reduces astigmatism by

0.25 to 0.50 D, and a 3-mm CCI reduces astigmatism by 0.75 to 1.00 D. For against-the-rule (ATR) astigmatism, a 2.4-mm temporal CCI with a phaco slit knife lowers astigmatism by 0.00 to 0.25 D, and a 3-mm CCI lowers it by 0.50 D. Opposite CCIs have a reduction effect of 2.50 D due to coupling. For laser-assisted cataract surgery, I prefer 2.4-mm CCIs, and the SIA is similar to CCIs created with a 2.4-mm phaco slit knife.

Surgical strategy for astigmatism. In cataract patients with corneal astigmatism, I evaluate the astigmatism with the help of corneal topography. For a monofocal IOL, if the corneal astigmatism is 0.50 D or less, I create 2.2- to 2.4-mm temporal CCIs. When there is ATR astigmatism of more than 1.00 D, I perform an opposite CCI. When there is WTR astigmatism of 0.75 to 1.00 D, I create a CCI on the superior, or steep, axis. When WTR astigmatism is 1.25 to 1.50 D or greater, I perform an opposite CCI. For an eye with more than 1.50 D of corneal astigmatism, I recommend a toric IOL. I prefer to use toric multifocal IOLs in patients with 0.75 D of ATR astigmatism or 1.25 D of WTR astigmatism.

Biometry and power calculation. At our hospital, we double-check our biometry measurements by using both the IOLMaster (Carl Zeiss Meditec) and ultrasound biometry. The IOLMaster software includes the Holladay, Holladay 2, Haigis, SRK-T, and Hoffer Q IOL power calculation formulas. In routine cases, I depend on the Holladay 2 formula, but, in extreme eyes, I prefer to use my own nomogram. If the patient's anterior chamber depth is greater than 4 mm, I increase the IOL power; if the anterior chamber depth is less than 2.75 mm, I decrease the IOL power by 0.50 to 1.00 D. In cases in which an opposite CCI will be created, I increase the IOL power by 0.50 D.

In extremely short eyes, I prefer to use the Hoffer Q and Haigis formulas on the IOLMaster, and, in extremely long eyes, I choose the highest power given by the SRK-T, SRK II, and Holladay formulas using optical biometry. In my experience, the Haigis L formula is not successful in postrefractive surgery cataract patients.

Whenever the A-scan equipment is renewed or upgraded, I closely observe my refractions until I am satisfied with them.

We recently started loading refractive data from our cataract patients into the Verion Image Guided System (Alcon), from which we will be able to obtain scientific information on outcomes in the near future.

LASER VISION CORRECTION

I perform refractive surgery in 10 eyes per day on average. This volume gives me sufficient data to precisely follow my refractive results. The IntraLase FS 150 Hz (Abbott Medical Optics) platform is a predictable device for LASIK flap creation. My routine flap depth is 110 µm, but, when I need a thinner flap I choose 90-µm thickness. The WaveLight Allegretto Wave Eye-Q IQ-400 excimer laser (Alcon) is also predictable, and I trust its spherical correction highly. It is my preferred device for patients with hyperopia. When cylinder is greater than 2.00 D, I decrease the amount of correction by 20%. I also make a slight reduction when sphere is greater than 6.00 D.

The Visx Star S4 IR excimer laser (Abbott Medical Optics) provides predictable cylinder correction. Since the introduction of the iDesign software, this has become my favorite tool for treating mixed astigmatism and cylinder greater than 1.00 D. With this device, some reduction in sphere is required in order to not overcorrect myopic patients.

The VisuMax femtosecond laser (Carl Zeiss Meditec) is my most recently acquired gadget, and I have completed nearly 500 ReLEx SMILE procedures to date. The VisuMax has become my favorite tool for high amounts of sphere, and it does not require a spherical or cylindrical nomogram. I do, however, wish it would compensate for cyclotorsional rotation.

CONCLUSION

In order to gauge how close we are to achieving optimal refractive outcomes, it is essential that we continually analyze our surgical results. Simple methods can be put into practice to collect and evaluate these data, bringing us one step closer to refractive excellence. ■

Haluk Talu, MD
- Senior Cataract and Refractive Surgeon at the Atakoy branch of Dunya World Eye Hospital, Istanbul, Turkey
- haluk.talu@dunyagoz.com
- Financial disclosure: None

OUTCOMES ANALYSIS SOFTWARE

IBRA System (Zubisoft)
www.zubisoft.com/http/overview.php

Datagraph-med (Datagraph-med)
www.datagraph.eu/index.php?getlang=de

SurgiVision DataLink (SurgiVision Consultants)
www.svc.surgivision.net/home/SVChome.html

ASSORT (ASSORT Surgical Management Systems)
www.assort.com/default.asp