

Measuring the Results of Refractive Surgery

We still need to improve quite a bit.

BY LEE T. NORDAN, MD



Now that improved keratorefractive surgery, phakic IOLs, and the surgical correction of presbyopia are becoming popular topics of conversation, it is time to reexamine a basic issue: testing the results of refractive surgery with a

Snellen chart. We all know that refractive surgery often reduces contrast sensitivity, yet we persist in measuring postoperative visual function with a test that was designed to measure refractive error and uses only letters at 100% contrast. This practice is tantamount to building a race car and timing its performance with a sundial. In other words, our measurements are not very meaningful.

THE VISUAL FUNCTION INDEX

Background

A Regan or Pelli-Robson chart is essentially a Snellen chart, but its letters progress from 100% to 12.5% contrast. Patients simply read the lowest line of letters they can. In my experience, the 25% contrast line is a good starting point, and variations in visual function become apparent at the 12.5% contrast line. These tests are as easy to administer as a Snellen test, and they have a definite endpoint. Measuring contrast sensitivity in the clinical setting that results in a curve is essentially a waste of time; a contrast sensitivity curve cannot be interpreted in an objective, concise, clinically significant manner in order to allow comparison with a norm or another eye's visual function.

In 1993, I edited *The Surgical Rehabilitation of Vision*.¹ In that textbook, I described the visual function index (VFI) and the surgical efficacy index. At the recent Aspen Invitational Refractive Symposium (a great meeting, by the way), Rick Baker, OD, a long-time friend and optometrist who works with Stephen Slade, MD, reminded me of the VFI. He again posed the question that I and many others have been asking for 15 years: Why are we still measuring the results of refractive sur-

“Why are we still measuring the results of refractive surgery with a Snellen chart?”

gery with a Snellen chart and then resorting to descriptive phrases such as “patients are happy”? *Happy* usually means that the patient's visual function is poorer than desired, but he isn't complaining ... today.

Rick and I agreed to make a concerted effort to improve the measurement of refractive surgery so that we can (1) accurately measure visual function and (2) develop a method for comparing the results of various refractive procedures.

The Terminology

To understand the VFI, one must learn a few terms. *D-VFI* stands for distance VFI, *N-VFI* for near VFI, and *B-VFI* for binocular VFI. *BN-VFI*, then, would stand for binocular near VFI. The VFI uses the 25% contrast line as the test letters and follows this equation: $VFI = 100 (VA) - \text{spherical equivalent}$.

Examples

No. 1

A 22-year-old patient who previously underwent LASIK presents with a refractive error of -1.00D sphere. He reads 20/30 on the 25% contrast line at distance.

$$D-VFI = 100 (20/30) - 10 [1.00] = 67 - 10 = 57$$

$$N-VFI = 100 (20/20) - 10 [1.00] = 100 - 10 = 90$$

No. 2

After LASIK surgery, a 45-year-old patient has a refractive error of +1.50D. She reads 20/30 at distance and 20/80 at near.

$$D-VFI = 100 (20/30) - 10 [1.50] = 67 - 15 = 52$$

$$N-VFI = 100 (20/80) - 10 [1.00] = 25 - 10 = 15$$

No. 3

A patient with bifocal pseudophakic IOLs reads 20/25 at distance and 20/40 at near with a plano refraction at distance for each eye.

$$D\text{-VFI} = 100 (20/25) - 10 [0] = 80$$

$$N\text{-VFI} = 100 (20/40) - 10 [0] = 50$$

No. 4

A 50-year-old patient treated with LASIK monovision sees 20/20 with a plano refraction in his right eye and 20/60 with a -1.50D correction in his left. The patient's bilateral VFI acuity is 20/30 at distance and 20/25 at near. Binocular testing used no spherical equivalent component.

$$BD\text{-VFI} = 100 (20/30) = 67$$

$$BN\text{-VFI} = 100 (20/25) = 80$$

These values could easily be compared to those of a different monovision patient.

No. 5

A patient undergoes an IOL exchange with accommodative IOLs. His visual acuity in each eye individually and bilaterally is 20/25 at distance and 20/40 at near.

$$BD\text{-VFI} = 100 (20/25) = 80$$

$$BN\text{-VFI} = 100 (20/40) = 50$$

Accommodative bifocal IOLs maintain contrast sensitivity but tend to lack add power. Bifocal optics reduce contrast sensitivity but can have very strong add power. The VFI can measure these trade-offs in terms of visual function.

DISCUSSION

The best VFI score at 20/15 and plano is 200. In reality, reading 20/20 at the 12.5% contrast level can be quite difficult, so a score of 100 or greater indicates that the subject has excellent visual function at all levels of contrast.

The simple VFI rating system incorporates some sophisticated concepts. For instance, there is a separate rating for near and distance vision. Additionally, the residual refractive error makes the accuracy of the procedure relevant. This approach to testing visual function will have important consequences when comparing large numbers of different techniques. The VFI for best-corrected distance visual acuity can detect the maximum visual function of an eye by eliminating the refractive error of the VFI calculation. The residual refractive error improves or decreases the near function and is reflected in the near VFI rating.

Also worth noting is that the VFI allows the objective comparison of eyes and of different methods of refractive surgery. For example, the VFI could make the results of an

accommodating versus a phakic bifocal IOL much more meaningful. Alternatively, it could permit an exploration of the true significance of the difference in visual function between LASIK for -2.00 versus -8.00D.

The binocular VFI allows testing of the total package of visual function (eg, a monovision vs an unoperated eye). Finally, 12.5% contrast letters correlate highly with visual function at night.

FUTURE PLANS

Rick is going to test the VFI on about 50 patients. We will tweak the formula as necessary. Then, we are going to ask 30 refractive and cataract/IOL surgeons to measure their postoperative patients using the VFI. After compiling the results, we are going to distribute a new, simple contrast sensitivity chart consisting of several Snellen (100% contrast) lines, 25% contrast lines, and 12.5% contrast lines.

We, along with as many colleagues who are willing, will present all of our refractive surgery data in Snellen and VFI formats in order to show the advantage of the latter. Ultimately, we hope that all major meetings and publications will adopt the VFI as the standard method of reporting results after refractive surgery and will require its use.

The time for a truly representative testing of refractive surgery's results has come. Such measurement will become more important as surgeons increasingly implant phakic bifocal IOLs, perform refractive lens exchange, and compare these modalities to keratorefractive surgery.

Don't be surprised if Rick or I ask you to try the VFI program. It's an important step in the right direction if we really expect to compare the various methods of refractive surgery in a meaningful way. Currently, we are behaving like cataract/IOL surgeons who know that single-vision pseudophakic IOLs provide an excellent result for distance vision but neither understand nor care to deal with contrast sensitivity.

It is time for refractive surgeons to give the subspecialty the respect it deserves, understand the compromises inherent in such surgery, and figure out a way to evaluate patients accordingly. The VFI is such a method, and it is as simple and inexpensive to use as a Snellen test. ■

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1. Nordan LT, Davison JA, Maxwell WA, eds. *The Surgical Rehabilitation of Vision: an Integrated Approach to Anterior Segment Surgery*. New York, NY: Gower Medical Pub; 1992.