Contrast sensitivity tests provide wealth of clinical information

Ronald Krueger

Dermot McGrath in London

Although not yet considered a standard examination for refractive surgery, contrast sensitivity tests can provide a wealth of useful clinical information in assessing the qualitative aspects of vision both before and after surgery, according to Ronald Krueger MD.

“There is a case to be made for contrast sensitivity testing to be included as a routine examination before and after refractive procedures such as LASIK and PRK,” said Dr Krueger, speaking at a special Clinical Research Symposium on ‘What hat needs to be measured in refractive surgery?” held during the XXIV Congress of the ESCRS.

Dr Krueger, medical director of the department of refractive surgery at the Cole Eye Institute of the Cleveland Clinic Foundation, Ohio, said that his recommendation would be to measure visual acuity using ETDRS charts in a darkened room in order to get a better sense of the quality of vision of patients before and after surgery. While acknowledging that contrast sensitivity tests and their analysis is a time-consuming and cumbersome process, he said that a simplified version of the test, perhaps using a low contrast acuity chart, could still be used as a type of screening procedure to identify patients with diminished contrast sensitivity.

“The idea is that by using a simplified screening test pre- and postoperatively, we can see whether there is a significant change or deviation that merits a more detailed examination.”

This would speed up the process while allowing us to take on board valuable data in assessing the true visual function of a patient,” he said.

Dr Krueger noted that some ophthalmic companies are starting to offer combined visual acuity and contrast sensitivity charts. One such chart by VectorVision, for example, presents ETDRS LogMAR acuity from 20/10 to 20/100 and one row of spatial frequency at 12 cycles/degree. The patient can be screened in the examination chair for both ETDRS acuity and contrast sensitivity. If a contrast sensitivity deficit is found, re-testing the patient with all four spatial frequencies using a more detailed chart is recommended.

Unlike the Snellen visual acuity test, which measures the ability to see objects or letters of different sizes, a contrast sensitivity test typically measures two variables, size and contrast. The ability to detect objects of different sizes at lower contrasts is expressed as a contrast sensitivity function (CSF). The test determines the person’s contrast detection threshold, the lowest contrast at which a pattern can be seen.

“Such tests are a potential indicator also of poor visual quality due to higher order aberrations and to light scatter. Basically it is quality of vision that is being measured, potential gain versus loss after surgery, and the functional impact of aberrations in the entire optical system as well as the impact of light scatter,” he said.

Light scatter in the ocular media, which increases with age, can affect contrast sensitivity without affecting visual acuity, said Dr Krueger. Light that is scattered within and between light sources imaged onto the retina causes degradation of the retinal image contrast over a wide range of spatial frequencies.

“A typical example is early cataracts where the visual acuity might be quite good but there is still some loss of contrast sensitivity. Vitreous floaters or mild corneal oedema can also have the same impact on contrast sensitivity without necessarily impairing visual acuity.”

Dr Krueger emphasised the central role played by wavefront sensors and aberrometers in modern refractive practices, the data from which provides the basis for evaluating several other functions that define optical quality such as point spread function (PSF) and modulation transfer function (MTF).

He explained that point spread function evaluates the quality of an optical system as it images a point source. While a perfect optical system will show an image of a point of light as an almost perfect representation of the same point of light, the point becomes distorted when aberrations are present. The data contained in the PSF also provides the basis to calculate another useful metric, the MTF, which measures contrast degradation as a function of spatial frequency. This provides a useful measure of the optical component of contrast sensitivity.

The case for custom ablation

In terms of the choice of refractive surgery procedure, Dr Krueger said that his own clinical experience, as well as other reports in published literature, suggest that customised laser treatments offer the best means of preserving contrast sensitivity function and reducing associated photopic phenomena.

“We recommend using custom ablation whenever possible because while the visual acuity outcomes may not differ greatly compared to standard algorithms, the contrast sensitivity is often better for patients who have been treated using custom ablation platforms,” he said.

In assessing patients for refractive surgery, contrast sensitivity testing can help in identifying potential problems with night vision, noted Dr Krueger.

“Difficulty with night driving vision is one of the most common complaints after refractive surgery. Contrast sensitivity testing has undoubtedly been helpful in characterising loss of visual function for these patients, often when their Snellen visual acuity has not shown any deterioration,” he said.

Dr Krueger added that contrast sensitivity also has a useful role to play in evaluating patients with incipient cataracts prior to undergoing refractive surgery.

“We recommend using custom ablation whenever possible because while the visual acuity outcomes may not differ greatly compared to standard algorithms, the contrast sensitivity is often better for patients who have been treated using custom ablation platforms.”

“This can be a great help in giving the clinician some objective means of deciding whether or not we can proceed with a LASIK or refractive lens exchange for these patients. It is also helpful in documenting an accurate level of detriment in terms of their contrast sensitivity after surgery,” he said.

krueger@ccf.org