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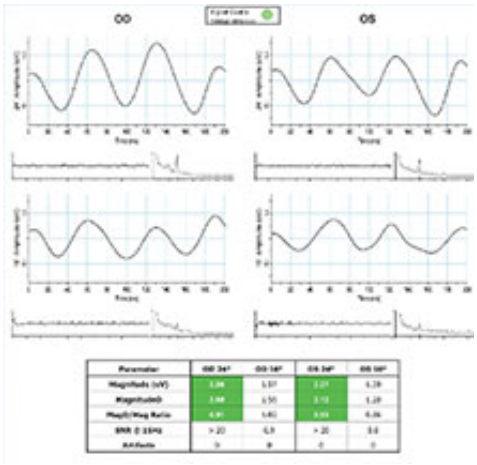
NEWS & OPINION

Electrophysiology in the clinic

by Farrell "Toby" Tyson, MD

Physician shares how office-based electrophysiology visual evoked potential and pattern electroretinography testing allow him to make a more exact diagnosis

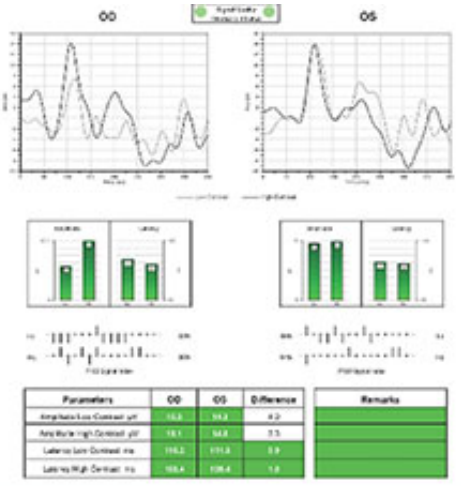
As a comprehensive ophthalmologist, I often see patients at the start of their journey into deteriorating vision. One of the most important services I can provide for these patients is a differential diagnosis and guidance on how they should proceed with their vision care. I have found that office-based electrophysiology visual evoked potential (VEP) and pattern electroretinography (PERG) testing (Diopsys NOVA, Pine Brook, N.J.) allows me to make a more exact diagnosis and recommend the best treatment options to my patients.



Normal ERG vision test

VEP and PERG testing

Human vision is the amalgamation of numerous different functional systems between the eye and the brain. However, most ophthalmologists' armamentariums include a variety of diagnostic modalities that almost all focus on the eye. Those that do focus on the whole process of interpretation of an image, such as visual acuity, Humphrey visual fields, and Amsler grids, are subjective and considered less reliable. Electrophysiology, on the other hand, provides objective analysis of the entire neuro-visual pathway including visual function, locality, and severity for diagnosis and treatment.



Normal VEP vision test
Source: Diopsys Inc.

VEP measures the amplitude and latency of electrical activity throughout the pathway of the visual cortex. Standard VEP testing uses predetermined pattern-reversal stimuli consisting of high contrast and low contrast checkerboards and then tracks the electrical activity generated from the retina to the visual cortex. It does not rely on any kind of active patient participation, making it the only objective, functional measurement of the entire visual system.

PERG testing is similar to VEP testing, but focuses on activity in the retinal ganglion cells. Glaucoma, for example, is characterized by progressive loss of retinal ganglion cells and their axons. Both VEP and PERG have proven effective at detecting early disease.[1] A recently published study found that abnormalities indicating disease in PERG testing preceded detection of disease via optical coherence tomography of the retinal nerve fiber layer by approximately 8 years.[2] This is a significant finding to help preserve vision in patients at risk of progressive vision loss from glaucoma.

In fact, several studies support the ability of PERG testing to detect the amount of damage to retinal ganglion cells early enough to allow viable cells to be restored.[3,4,5] This presents a huge change in the way we approach glaucoma to minimize functional loss and its effects on vision.

Clinical use

We purchased the Diopsys NOVA Vision Testing System and have found it very easy for all of our technicians to use correctly. The test results are easy to interpret and very helpful in our diagnosis and treatment of patients. Technological developments by Diopsys have also resulted in non-invasive sensors, faster testing time and improved data collection, making

electrophysiology a practical tool for office use.

It is often difficult to determine treatment for patients with ocular hypertension. Visual field tests, if reliable, do not show abnormalities until nearly 30% of the optic nerve is irreversibly damaged. OCT visualization of the nerve fiber layer may pick up damage earlier, but many patients with ocular hypertension show no changes or only borderline pathology on OCT. If I have a patient with OHT and a normal appearing optical nerve, I want PERG testing using both high and low contrast so that I can determine if this is just an individual with a naturally higher IOP or a patient in the earliest stages of retinal dysfunction.

For patients with known glaucoma, PERG testing provides an excellent measurement of disease status for patients in treatment. I then repeat the testing as needed to analyze whether the results of our treatment are maintaining the health of the ocular pathway. If it is degrading, I know we may need to alter care. For example, 18 mm Hg may be a good target pressure in some patients, while in others it may simply be too high. PERG data results help to take the guesswork out of my job.

We have had several patients that maintained an IOP of 22 mm Hg in one eye and 25 mm Hg in the other eye consistently for up to 3 years, with normal results on visual field and OCT testing. When I first got the Diopsys NOVA Vision Testing System I tested these patients for subclinical changes to their retinal function. On one such patient, I found that the VEP results were normal in the eye with a pressure of 22 mm Hg, but saw a loss of amplitude and a delay in the low contrast latency measurements on the other eye, results specific to glaucoma. We initiated treatment and after 6 months of prostaglandin, the patient had normalization of the waveform and improvement of the signal. It is exciting to be able to treat patients at a point where this is still potential for improvement, rather than just maintenance.

We have found VEP and PERG testing to be useful beyond its known uses for malingering and multiple sclerosis. Many other pathologies have subclinical functional damage that benefits from earlier intervention with the help of VEP and PERG. These include macular degeneration, epiretinal membranes, diabetic retinopathy, macular edema, glaucoma, and more. In addition, we perform these tests on patients seeking multifocal intraocular lenses. It is helpful to know if patients have any defects or existing loss of contrast sensitivity prior to implanting multifocal lenses.

In one specific case, a cataract patient interested in premium lens options reported prior optic neuritis in one eye due to multiple sclerosis, but did not remember in which eye. Upon testing the patient with VEP, one eye had normal latency and amplitude while the other was outside the reference range. We adapted our IOL recommendations for this patient to avoid any post-surgical surprises and buyer's remorse.

Good vision is dependent on so much more than healthy rods and cones. It is very exciting to have the ability to bring electrophysiology to the clinic to measure the function of patients' vision and positively influence our daily medical decisions. Electrophysiology gives me a greater understanding of each patient's needs and improves our ability to care for them.

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Editors' note: *Dr. Tyson has no financial interests related to this article.*

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