VEP and ERG in Optometric Practice
Primary Care Electrodiagnostics

Peter H Kehoe, OD, FAAO
Diplomate – American Board of Optometry
COPE Course ID # 36510
Disclosures

• Affiliated with Transitions Optical as a consultant for professional development
• Former Non-executive board member of Optos, Plc based in Scotland
  – Consultant to Optos, Inc.
• Consultant and Scientific Advisory Board Member - Diopsys, Inc.
• Administrator for Vision Source in Illinois
BIOGRAPHY

• Principal in 2 practices in Galesburg, and Galva, IL
• Past-President, of the American Optometric Association
• Optometric contractor to Illinois Department of Corrections
• ICO Class of 1984
• Fellow, American Academy of Optometry
• Doctor of Science in Optometry – ICO 2009
• Diplomate – American Board of Optometry – 2011
• Fellow – National Academies of Practice - 2013
ISCEV

International Society for Clinical Electrophysiology of Vision

http://www.iscev.org/
Mission

To promote and extend the knowledge of clinical electrophysiology of vision.

To promote co-operation and communication among workers in the field of clinical and basic electrophysiology of vision.
ISCEV
Standards, Recommendations and Guidelines
VISUAL ELECTRODIAGNOSTICS A Guide To Procedures

Confirmation of Neurological or Ophthalmological Disease
Unexplained Visual Loss
Pediatric Neurology
Opacities in Media
Monitoring Health - Toxicity
Detection of the Disease or Carrier States of Inherited Visual Disorders
Quantitative Assessment of Visual Disease
Assessment of Retinal and Optic Nerve Function Following Trauma
Infants with questionable vision

http://www.iscev.org/standards/proceduresguide.html
ISCEV
Standards, Recommendations and Guidelines
VISUAL ELECTRODIAGNOSTICS A Guide To Procedures

Vascular Disease of the Eye Including Diabetes
Opaque Media
Retrobulbar Neuritis
Unexplained Visual Loss
Pediatric Cases
Albinism
Toxic and Nutritional Eye Disease
Intracranial Lesion

http://www.iscev.org/standards/proceduresguide.html
AAO
American Academy of Ophthalmology
Preferred Practice Patterns

http://one.aao.org/CE/PracticeGuidelines/PPP.aspx

AOA
American optometric Association
Clinical Practice Guidelines

http://www.aoa.org/x4813.xml
Neuro-Physiology

Light

- Photoreceptor
  - Mid-retinal Layers
    - Bipolar
      - Ganglion cell axon
        - Optic Chiasm/Tract
          - Relay neuron
            - LGN
              - Visual cortex neuron

Phototransduction
Conversion of light into electricity
Electrophysiology

- Electrocardiogram
- Electromyography
- Auditory Evoked Potential
- Electroencephalogram
VISUAL EVOKED POTENTIAL (VEP)

- Electric signal registered at the occipital region in response to a visual stimuli.
- VEP
  - Visual – patient observes a visual stimulus
  - Evoked – generates electrical energy at the retina
  - Potential – measure the electrical activity in the visual cortex
- Measure the function of the entire vision system; no patient response required – OBJECTIVE TEST 😊
Previous Limitations

• Test time was approximately 45 minutes

• Required highly trained operators

• Required highly trained interpretation (subjective)

• Limited to large research institutions
Advantages of Current Technology

• Test time is approximately 1 minute
• Does not require highly trained operators
• Does not require highly trained interpretation (subjective)
• Currently installed in about 2000 offices (one company) 2 or three other companies - limited
VEP Electrodes

Reference  Ground  Active
VEP Stimulus

- Flash
- Pattern
  - Reversal
  - Pattern-onset
  - Transient
  - Steady State
• Pattern
  Contrast Sensitivity
  Visual Acuity
  Color
VEP Components

P100
Depolarization
N75
N135
VEP

AMPLITUDE
Microvolts (µv)

LATENCY
Milliseconds (ms)

1 Volt = 1,000,000 Microvolts
1 second = 1000 milliseconds
Amplitude usually translates to the amount of axons conducting along the visual pathway.

Latency usually translates to the myelin status of the visual pathway.

**VEP**
Other Electrophysiological Tests

Electroretinogram
Multifocal Electroretinogram
Pattern Electroretinogram
Electrooculogram
Multifocal Visual Evoked Potential
VEP and other Ophthalmic Diagnostic Tests

- Psychophysics
- VF
- GDx
- HRT
- OCT
Psychophysics of Vision

Visual Acuity Test
Psychophysics of Vision

Visual Field Test
OPTIONS FOR CUSTOMIZED VEP TESTING

• User-Defined Protocol
  • LKC
  • Diagnosys
  • Diopsys® NOVA-TR

• Customize testing parameters specific to each patient and pathology
  • Pattern Type & Size, Contrast level, Eye

• Testing times are flexible and depend upon the customized settings
EXAMPLE:
2 DIFFERENT SPATIAL FREQUENCIES

16 X 16

64 X 64
RESPONSE TO TREATMENT EXAMPLE

Graph showing comparison between OU with Lens and OU without Lens.
MULTIPLE SCLEROSIS EXAMPLE

Expected P100 timing

Actual P100 timing
ABILITY TO USE FIXED PROTOCOLS

- Multi-Contrast Stimuli
  - LKC Requires User to Create Fixed
  - Diopsys® NOVA-LX

- Easy to follow fixed protocol guides the technician through the test procedure.

- Testing time takes 38-53 seconds per eye on Diopsys, or about 5 minutes total – about 1/3 of LKC
VEP AND GLAUCOMA: WELL DEFINED SCIENCE

THE VISUAL EVOKED POTENTIAL IN GLAUCOMA AND OCULAR HYPERTENSION: EFFECTS OF CHECK SIZE, FIELD SIZE, AND STIMULATION RATE

INVEST OPHTHALMOL VIS SCI 24:175-183, 1983
Increased pattern VEP latency was significantly correlated with both the severity and location of visual field defects and the degree of cupping and pallor of the optic disc. 

The authors of this paper are world recognized electrophysiology specialist form New England Medical Center and University of Chicago.
The Visual Evoked Potential in Glaucoma and Ocular Hypertension: Effects of Check Size, Field Size, and Stimulation Rate

Vernon L. Towle, Anne Malinowicz, Samuel Soirot, and Bernard Schwartz

In order to determine the optimum stimulus conditions for the detection of optic nerve damage due to glaucoma and ocular hypertension, checkerboard pattern reversal visual evoked potentials (VEPs) were recorded from 20 glaucoma patients, 20 ocular hypertensive patients, and 20 age-matched normals. Two check sizes (12` and 48`) and two field sizes (14` and 28`), and two alteration rates (1.9 and 7.5 alt/sec) were used. All subjects had visual acuities of 20/40 or better in each eye and equal pupils of 2 to 5 mm diameter. The largest number of VEP abnormalities were found with large checks (48`) reversing at a fast rate (7.5 alt/sec). After correcting for the effects of age, visual acuity, and pupil size, 16 of 30 eyes with glaucomatous visual field defects had abnormally long VEP latencies under this condition (beyond the 99% confidence limit of the normal subjects). Nine of 40 ocular hypertensive eyes also had abnormally long latencies. Increased pattern VEP latency was significantly correlated with both the severity and location of visual field defects and the degree of cupping and pallor of the optic disc. VEP latency was not significantly related to intraocular pressure. Invest Ophthalmol Vis Sci 24:175–183, 1983

The pattern visual evoked potential (VEP) has been shown to be sensitive to optic nerve lesions caused by degeneration, ischemia, and compression of the anterior visual pathway. Glaucoma has also been reported to affect the VEP by causing both reductions in amplitude and increases in latency. In optic disc cupping and the presence of visual field loss, VEP latencies have been normal unless eccentric viewing or provocative techniques have been employed.

In those nonprovocative studies in which abnormally long VEP latencies were obtained, it is not clear whether the results were due, in part, to the confounding effects of miotic pupils, advanced age, or reduced visual acuity. All three of these factors can cause VEP latency increases. The one study that carefully controlled for the effects of these three variables reported a small group difference in relative interocular VEP latency for glaucoma patients and normal control subjects.

The purpose of the present study was to obtain VEP latencies for various stimulus conditions in carefully selected groups of ocular hypertensive and glaucoma patients and visually normal controls while controlling for the confounding effects of pupil size, age, and visual acuity.

Materials and Methods

Subjects

All subjects were free from neurologic disease, had clear media, visual acuities of 20/40 or better in each eye, and equal pupils of 2 to 5 mm diameter. The 60 subjects formed three groups of 20 subjects each, as described below.

Group 1: Normal controls. This group consisted of ten volunteers (five men and five women) less than 50 years of age (mean = 30 years) and ten volunteers (six men and four women) older than 50 (mean = 63 years). All of these subjects had normal fundi and discs, fall and normal visual fields as measured on the Goldmann perimeter by static and kinetic methods, and ocular pressures less than 21 mmHg as measured by the Goldmann applanation tonometer. Stereoscopic fundus photographs were taken with the Donaldson stereoscopic fundus camera from six of these subjects.
faster alternation rate yielded the largest difference between normals and glaucoma patients suggests that transient channels may be more susceptible to glaucoma damage than sustained channels. Bodis-Wollner has reported similar findings in a glaucoma patient. This is also suggested by a psychophysical study by Tyler, who reported “notch” losses in flicker sensitivity at relatively high flicker rates. Atkin's sound deficits in contrast sensitivity using patterns whose contrast changed at 8 Hz. It may be that ganglion cells comprising transient channels are more susceptible to the increased pressure or ischemia hypothesized to play a role in glaucomatous damage.

The finding that is of clinical importance is the presence of abnormally long VEP latencies in some patients with ocular hypertension. The abnormal prolongation of VEP latency in these eyes may reflect subclinical optic nerve lesions that have not been uncovered with other techniques.

**VEP Latency and Ocular Hypertension**

The finding that is of clinical importance is the presence of abnormally long VEP latencies in some patients with ocular hypertension. The abnormal prolongation of VEP latency in these eyes may reflect subclinical optic nerve lesions that have not been uncovered with other techniques.
WHY VEP?

- Many optic nerve diseases are asymptomatic because central vision is not affected until late in the disease\(^1\)

- Diagnosis and management of optic nerve disorders are often based on structural or subjective visual field tests\(^2\)

VEP is an **objective**, **functional** test that can help discriminate between healthy and glaucomatous eyes\(^2\)

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Main Indications

• Glaucoma
• Multiple Sclerosis
• Ischemic Optic Neuropathy
• Traumatic Brain Injury
• Amblyopia
• Other Neuropathies
HOW WE TEST

• Low contrast testing demonstrates degradation of magnocellular pathways
  • An early indication of glaucoma

• High contrast testing demonstrates degradation of parvocellular pathways
  • An early indicator of central vision loss and issues caused by problems before signal reaches optic nerve

**patient should be tested with best corrected vision**
ASSESSMENT OF NEURO-VISUAL FUNCTION

Diopsys® VEP Report

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<th>Parameters</th>
<th>OD</th>
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<th>Difference</th>
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<td>6.4</td>
<td>1.3</td>
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Remarks: Current VEPs MARGINALLY affected

Operator: TA

Diopsys - S78

Signature:
ASSESSMENT OF NEURO-VISUAL FUNCTION

Diopsys® VEP Report

First Name: Deanna
Last Name: Holtman
DOB: 6/6/1940
Age: 72
Gender: Female
Exam Date: 6/27/2012
Exam Time: 12:15 PM
OD: -1.00 + 0.75 x 180
VA: 20/20
OS: -1.00 x 30
VA: 20/20

Signal Quality
Voltage.arm: 2500

Latency
High Contrast

Amp (μV)

Time (ms)

Low Contrast

High Contrast
Diopsys® VEP Report

ASSESSMENT OF NEURO-VISUAL FUNCTION
ASSESSMENT OF NEURO-VISUAL FUNCTION

Diopsys® VEP Report

First Name: Deanna  Last Name: Hoffman  DOB: 6/6/1940  Age: 72  Gender: Female
Exam Date: 2012-07-27  Exam Time: 12:21:50 AM
OD: VA 20/20  OD: VA 20/20
OS: VA 20/20  OS: VA 20/20

Lc 92%  Lc 78%
Hc 100%  Hc 94%
P100 Reliability Index

Parameters    OD    OS    Difference
Amplitude Low Contrast, µV    7.8    6.4    1.4
Amplitude High Contrast, µV    6.7    5.6    1.1
Latency Low Contrast, ms    121.1    128.1    7.0
Latency High Contrast, ms    162.5    164.5    2.0

Remarks: Current Baseline selected. Diopsys technician's signature: Diopsys - S78

Operator: TA  Comments:  Signature: www.Diopsys.com
Diopsys® VEP Report

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READING THE RESULTS

• Quickly interpret results to enhance medical decision making and treatment planning

• Easy-to-read reports allow clinician to demonstrate therapeutic results and monitor disease progression
READING RESULTS: NORMAL
READING RESULTS: ABNORMAL
MULTI-FOCAL ERG
THANKS TO:

Nathan Lighthizer, O.D., F.A.A.O
Assistant Professor, NSUOCO
Chief of Specialty Care Clinics
Chief of Electrodiagnostics Clinic
Photopic ERG of the central retina
Tests the central retinal function

35-40 degrees of central retina
Step 4 from the full-field ERG
Multifocal ERG (mfERG)
Multifocal ERG (mfERG)

- Trace Array

Step 4 from the full-field ERG

Amplitude = 100 - 200 μV
Latency = 20 - 25 msec

Photopic 0 dB Flash

1uV
100 msec
Multifocal ERG (mfERG)

- **Ring Ratios**

**Normal ring ratios**

![Image showing normal ring ratios with values](image1)

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<tr>
<th>Amp (nV/deg2)</th>
<th>Ring-Ratio</th>
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<td>72.46</td>
<td>1.63</td>
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<tr>
<td>44.33</td>
<td>2.72</td>
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<tr>
<td>26.69</td>
<td>3.75</td>
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<td>19.32</td>
<td>4.39</td>
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**Elevated ring ratios**

![Image showing elevated ring ratios with values](image2)

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<th>Amp (nV/deg2)</th>
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</thead>
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<tr>
<td>2.73</td>
<td>75.97</td>
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<td>5.12</td>
<td>27.80</td>
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<tr>
<td>6.37</td>
<td>14.84</td>
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<tr>
<td>9.04</td>
<td>11.92</td>
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<tr>
<td>8.43</td>
<td>8.41</td>
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Means

99% limits of normal

![Graph showing normal ring ratios for a 68-year-old](image3)
Multifocal ERG (mfERG)

- Very good for:
  - Detecting small areas of damage to the central retina
    - ***Plaquenil toxicity***
  - Detecting areas of functioning retina remaining
Eye stimulation by a checkerboard pattern elicits a ganglion cell response known as PERG.

PERG is an accurate and objective indicator of ganglion cell and macular function. (ISCEV)

PERG can detect retinal dysfunction (OHT) before structural tests. (Parisi et al.)
ASSESSMENT OF NEURO-VISUAL FUNCTION

pERG
INTERNATIONAL PERG STANDARD

- Time is measured in milliseconds (ms)
- Amplitude is measured in microvolts (uV)

N35-P50-N95 Complex
- N35: Negative Pulse around 35ms
- P50: Positive pulse around 50ms
- N95: Negative pulse around 95ms
ASSESSMENT OF NEURO-VISUAL FUNCTION

pERG Electrodes
ASSESSMENT OF NEURO-VISUAL FUNCTION

ERG Electrodes

Comfort       Convenience       Quality
Clinical Ability of Pattern Electroretinograms and Visual Evoked Potentials in Detecting Visual Dysfunction in Ocular Hypertension and Glaucoma

Vincenzo Parisi, MD,1 Stefano Miglior, MD,2 Gianluca Manni, MD,1,3 Marco Centofanti, MD,1,3 Massimo G. Bucci, MD1,3

The Pattern Electroretinogram in Glaucoma Patients with Confirmed Visual Field Deficits

Donald C. Hood,1 Li Xu,1 Phamornsak Tbienprasiddhi,2 Vivienne C. Greenstein,3 Jeffrey G. Odel,2 Tomas M. Grippo,2 Jeffrey M. Liebmann,2 and Robert Ritch4

Pattern ERG as an Early Glaucoma Indicator in Ocular Hypertension: A Long-Term, Prospective Study

Michael Bach,1 Anke S. Unsoeld,1 Heiko Philippin,1 Flemming Staubach,1 Philip Maier,1 Hans S. Walter,2 Thomas G. Bomer,5 and Jens Funk1

Repeatability of Pattern Electroretinogram Measurements Using a New Paradigm Optimized for Glaucoma Detection

C. Bowd, A. Tafreshi, G. Vizzeri, L.M. Zangwill, P.A. Sample, and R.N. Weinreb
Hamilton Glaucoma Center and Department of Ophthalmology, University of California, San Diego, La Jolla, CA, USA.

Glucoma

Pattern Electroretinogram in Glaucoma Suspects: New Findings from a Longitudinal Study

Sebastian F. N. Bode,1 Thomas Jeble,2 and Michael Bach1
Progressive loss of retinal ganglion cell function precedes structural loss by several years in glaucoma suspects.

Bascom Palmer Eye Institute, University of Miami Miller School of Medicine, Miami, Florida.

Abstract
PURPOSE: We determined the time lag between loss of retinal ganglion cell function and retinal nerve fiber layer (RNFL) thickness.

METHODS: Glaucoma suspects were followed for at least four years. Patients underwent pattern electroretinography (PERG), optical coherence tomography (OCT) of the RNFL, and standard automated perimetry testing at 6-month intervals. Comparisons were made between changes in all testing modalities. To compare PERG and OCT measurements on a normalized scale, we calculated the dynamic range of PERG amplitude and RNFL thickness. The time lag between function and structure was defined as the difference in time-to-criterion loss between PERG amplitude and RNFL thickness.

RESULTS: For PERG (P < 0.001) and RNFL (P = 0.030), there was a statistically significant difference between the slopes corresponding to the lowest baseline PERG amplitude stratum (≤50%) and the reference stratum (>90%). Post hoc comparisons demonstrated highly significant differences between RNFL thicknesses of eyes in the stratum with most severely affected PERG (≤50%) and the two strata with least affected PERG (>70%). Estimates suggested that the PERG amplitude takes 1.9 to 2.5 years to lose 10% of its initial amplitude, whereas the RNFL thickness takes 9.9 to 10.4 years to lose 10% of its initial thickness. Thus, the time lag between PERG amplitude and RNFL thickness to lose 10% of their initial values is on the order of 8 years.

CONCLUSIONS: In patients who are glaucoma suspects, PERG signal anticipates an equivalent loss of OCT signal by several years.
Main Indications

• Maculopathies
• Glaucoma

pERG
STEADY STATE – PATTERN ERG CONTRAST AND CONCENTRIC STIMULUS FIELD TESTING

• BCVA
  • Patient should be tested with best corrected vision

• 85% contrast – or High 85% and Low 15% Contrast

• 24” testing distance

• Right Eye (OD) then Left Eye (OS)
  • 8 second “warm up”
  • 20 seconds at 24° - Used for Hc and Lc
  • 20 seconds at 16°
ERG PROTOCOL SELECTION

Chronic Open Angle Glaucoma
Diabetic Retinopathy

AMD
Diabetic Retinopathy
Diabetic Macular Edema
Toxic Maculopathies
Healthy VF Glaucoma
Documented structural damage

Non documented structural damage

OCT

Documented functional damage

PERG/VEP

OHT

Non documented functional damage

VF


Parisi V, Miglior S, Manni G, Centofanti M, Bucci MG. Clinical ability of pattern-electroretinograms and visual evoked potentials in detecting visual dysfunction in ocular hypertension and glaucoma.
As measured by PERG, progressive loss of RGC function in early glaucoma is hindered after IOP lowering.

Steady-State pERG Waveforms

OD

OS

Artifact Indicator

Frequency Distribution

15 Cycle

60 Cycle
Normal Concentric Stimulus Fields

Normal Contrast Sensitivity
Abnormal Concentric - ARMD

Abnormal Contrast - Glaucoma
BASIC PREMISE OF OUR PRACTICE.....

If it is good for the patient.....

It will be good for the practice!
OUR GALESBURG PRACTICE

- 4 optometrists – two FT equivalent
- 6 exam lanes
- Pre-Test
  - FDT - AR/AK - LM – Topograher - Optos
- Special Testing Room #1
  - HVF - HRT
- Special Testing Room #2
  - Heidelberg Spectralis – PHP - QuantifEYE – Diopsys VEP
- Vision Therapy Specialty – Dr. Carter
TECHNOLOGY CONSIDERATIONS TODAY

• Does it do something our other technology doesn’t?
• Will it provide clinical information that will impact the treatment of our patients?
• Can it be incorporated into our office?
  • Space – Patient Flow - Staff
• Is it “standard of care” or “leading edge”?
• Is it “patient friendly”?
• Will it be profitable and/or Practice Builder?
  • Efficiency – Billable - Referrals
VEP IS GOOD FOR THE PATIENT….

- Technology has always been a highlight of our practice
- Glaucoma went away……but came back in 1994 with TPA’s
- Visual Fields traditionally the only measure of “function”
  - Very subjective and patients don’t like the test
- But now VEP can be incorporated in any practice
  - NOT subjective – and patients like the test
- For structure, we use OCT and HRT
  - Objective and able to detect subtle changes
VEP – DOES IT DO SOMETHING DIFFERENT?

- Absolutely! – However, not the research based, school based systems that may or may not have been at your school
- VEP results are a representation of the functional integrity of all levels of the visual pathway including anterior seg, retina, optic nerve, LGN and visual cortex
- An objective way to measure “function” for a variety of conditions
  - Glaucoma – MS – Amblyopia – Stroke – TBI
  - InfantSEE®
DOES THE VEP IMPACT TREATMENT?

• ABSOLUTELY!

• Glaucoma
  • Adjunct to visual fields (especially low reliability)
    • We now have 3 measures of “function” to go with 2 measures of “structure”
  • Developmental Disabled Patients – unable to do VF and even OCT/HRT

• Amblyopia
  • Predictor of success and monitoring therapy
CLINICAL EXAMPLE #1 - AQ 11 Y.O. FEMALE

- Patient since 2008 in combination with IA City Ophthalmology
- Progressively more near sighted each year with good BCVA
- 4/2/2012 presented complaining of daily HA’s for 2 months and vision “not clear”. Full work ups at IA City found a seizure disorder with EEG and Johns Hopkins diagnosed malingering
- BCVA on 4/2/2012 was 20/150 OD, OS - cyclopleged
- Ocular health otherwise normal with c/d’s of .7x7 OU
- Ordered VEP and HVF
AQ – 11 Y.O. FEMALE 4-11-12 VISUAL FIELDS
AQ – 11 Y.O. FEMALE 4-11-12 VEP

- Normal Amp and Latency and essentially equal between eyes
- Another validation of no organic cause of reduced BCVA
- Since no refractive error asymmetry or strabismus “not amblyopia” – Streff Syndrome
- 6 weeks into vision therapy was 20/20 OD, OS
CLINICAL EXAMPLE #2 – JH 63 Y.O. FEMALE

- No Family History of glaucoma – had been watching her for reduced macular pigment, although no history of ARMD
- Each year, did poorly on FDT screening fields, with many fixation losses, but normal confrontations.
- 10/5/10 Exam showed advanced FDT changes from 2009 IOP was 16,17 c/d remained at .2x.2 OU with right PPA. Pachymetry was 583, 592
- 12/3/10 Returned for VF, OCT and HRT
CLINICAL EXAMPLE #2 – VISUAL FIELDS 12-3-10
J.H. – HRT AND OCT12-3-10
J.H. – FOLLOW UP AND VEP

- 3/1/11 IOP 19,18 gonio open
- 6/28/11 VEP
  - Right is essentially normal Amp / Latency
  - Left shows reduced High Contrast Amp but increased Low Contrast Latency
- Order repeat VF
J.H.—VISUAL FIELDS 7-1-2011
J.H. VF 7-9-13

Eye Left
Baselines: SITA-Fast
Pattern Deviation: Graytone
07-01-2011: DOB: 06-11-1947
GHT: Outside normal limits
*** Low Test Reliability ***

Central 24-2: Threshold Test
GHT: Borderline
Pattern Deviation: Graytone
12-03-2010
MD: -0.02 db
P: 0.05
PSD: 1.84 dB
VFI: 98%
Fovea: OFF
FN: 0%
FP: 11%
FL: 7/10

FL: 1/10
VFI: 98%
Wheel: 0.00 dB
P: 0.6%
PSD: 1.54 dB
VFI: 98%

No Progression Detected

Rate of Progression: <0.01-0.75/yr (95% confidence)
Stop not significant
Follow-up:
07-09-2013
GHT: Borderline
Pattern Deviation:
Deviation From Baseline:
Progression Analysis:
6.0 mm
20/20

Previous Follow-up Exams:
07-03-2012
10-19-2012
KEHOE EYECARE, PC
4L PLAZA, SUITE 95
GALESBURG, IL 61401
309-343-1179

Notes:
© 2007 Carl Zeiss Meditec
HFA II 740-15264-4.2.2
PATIENT J.H. – PRE CAT SX VEP’S 2-25-13 & 7-17-13
PATIENT – J.H. ERG’S ON 7-17-13
PATIENT J.H. – S/P CATARACTS 5-19-14

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<td>1.0</td>
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**Remarks**

- Magnitude (μV)
  - OD 24°: 1.84
  - OD 16°: 1.37
  - OS 24°: 1.44
  - OS 16°: 1.11

- MagnitudeD
  - OD 24°: 1.66
  - OD 16°: 0.88
  - OS 24°: 1.13
  - OS 16°: 0.54

- SNR @ 15Hz
  - OD 24°: 8.3
  - OD 16°: 2.8
  - OS 24°: 5.1
  - OS 16°: 2.2

- Artifacts
  - OD: 0
  - OS: 3

**Odds Ratio**: 73%
PATIENT – J.H. 12-9-2014 (IOP ABOUT 13 ON TX)
PATIENT JH  3-3-15 (NO TX FOR 3 MONTHS – IOP 17)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>OD</th>
<th>OS</th>
<th>Difference</th>
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</thead>
<tbody>
<tr>
<td>Amplitude Low Contrast</td>
<td>11.8</td>
<td>8.7</td>
<td>3.1</td>
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<tr>
<td>Amplitude High Contrast</td>
<td>13.3</td>
<td>6.9</td>
<td>6.4</td>
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<tr>
<td>Latency Low Contrast</td>
<td>117.2</td>
<td>128.9</td>
<td>11.7</td>
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<td>Latency High Contrast</td>
<td>104.5</td>
<td>107.4</td>
<td>2.9</td>
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</table>

Remarks:
- Borderline Delayed
PATIENT JH – 3-3-15 (NO TX FOR 3 MONTHS – IOP 17)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>OD Hc</th>
<th>OD Lc</th>
<th>OS Hc</th>
<th>OS Lc</th>
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<tbody>
<tr>
<td>Magnitude (uV)</td>
<td>2.34</td>
<td>1.73</td>
<td>3.04</td>
<td>1.83</td>
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<td>MagnitudeD</td>
<td>2.01</td>
<td>1.08</td>
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<td>1.62</td>
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<tr>
<td>MagD/Mag Ratio</td>
<td>0.86</td>
<td>0.63</td>
<td>0.90</td>
<td>0.89</td>
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<tr>
<td>SNR @ 15Hz</td>
<td>7.5</td>
<td>2.0</td>
<td>4.6</td>
<td>5.9</td>
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<td>Artifacts</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
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</tbody>
</table>
JH – “WHY WE PURCHASED THIS TECHNOLOGY”

• The initial VEP prompted more testing and starting treatment early
• The VEP and ultimately the pERG allowed to watch the nerves progressively under more stress
• Removing the cataracts ultimately lowered pressures and allowed nerves to return to health
• Sensitivity allowed removal of treatment
• And ultimately back on treatment
• WE PREVENTED STRUCTURAL DAMAGE
OUR GLAUCOMA PROTOCOL – INCLUDING VEP/ERG

- Annual exam – include photos - dilated
- 3 or 4 month visit – non dilated
  - IOP – Gonio (UBM) – VEP (95930) ERG (92275)
- Next 3 or 4 month visit – dilated
  - HVF – HRT – OCT
  - Initially did many VEP with this visit at the beginning to get initial data on our patients. Slows the flow in our system because it is preferred to do VEP un-dilated
OUR ARMD/DIABETIC PROTOCOL – INCLUDING ERG

- Annual exam – include photos - dilated
- We Do Macula Risk on all patients
  - Helps determine frequency of visits
  - Helps guide proper supplement prescribing
- Typical “Quarterly” Q4Months, Once a Year Etc. (Dilated)
  - pERG (concentric) – PHP - OCT
- For Diabetic Retinopathy (must have retinopathy)
  - OCT and pERG (concentric)
PROFITABILITY

- We have had TWO coverage issues with any insurers including Illinois Medicaid CPT code – 95930/92275
- Medicare Allowable in “rest of IL” reimburses $123.20 / $149.87
  - OCT (92133) = $43.21 ($40.12)
  - Fundus Photos (92250) = $73.67 ($63.67)
  - HVF (92083) = $61.45 ($55.45)
- In Illinois there are no diagnosis codes associated/limited to CPT code – 95930 or 92275
  - No frequency limitations, but except for TBI/Stroke or Amblyopia – we will limit it to annually
- 2013 Revenue exceeded $80,000 from 95930 and 92275
OUR MOST COMMON DIAGNOSIS CODES

- 377.14 – Glaucomatous Atrophy (cupping) of optic nerve
- 368.4X – Visual Field Defect (abnormal VF – screening FDT)
- 368.0X – Amblyopia
- 377.11 – Primary Optic Atrophy
- 377.00 - Papilledema
- 368.12 – Transient Visual Loss
- 362.xx (now for pERG

LCD’s list over 80 diagnosis codes
YOU DO YOUR OWN MATH

• How many 365.xx patients do you have?
• How many 368.xx patients do you have?
• How many 377.xx patients do you have?
• How many 362.xx patients do you have
• If you do a screening FDT or other visual field – how many of them do you currently bring back for a full visual field – you should now consider adding a VEP to the battery of tests
• How many patients each year come in with “unspecified visual disturbance or transient visual loss”? 
IN SUMMARY – VEP + ERG

• Good for The Patient
  • Patients accept and understand the technology
  • Objective data with no patient stress

• Good for The Practice
  • Valuable clinical data for a variety of diagnoses
  • Easily incorporated into practice flow
  • A source of professional and patient referrals
  • One of the highest reimbursed procedures in the practice
QUESTIONS?

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