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# VEMP Testing and Analysis with the GSI Audera Pro

Karen Morris, Product Manager GSI

gsi Grason-Stadler

# MEET THE TEAM

Our Audiology team has over 65 years of experience presenting audiology and product knowledge to professionals around the world. Our ADVANCE team enjoys all things audiology and are ready to assist you with any questions. Please reach out to our education team at audiology@grason-stadler.com.

LAURA PRIGGE, AUD
GSI CLINICAL APPLICATION SPECIALIST

KAREN MORRIS, MS, CCC-A
PRODUCT MANAGER

TONY LOMBARDO, MS
GSI CLINICAL APPLICATION SPECIALIST

# Agenda

- Overview of cVEMP testing
- Overview of oVEMP testing
- Utilizing the VEMP Analysis Module
- 2021 VEMP CPT Codes

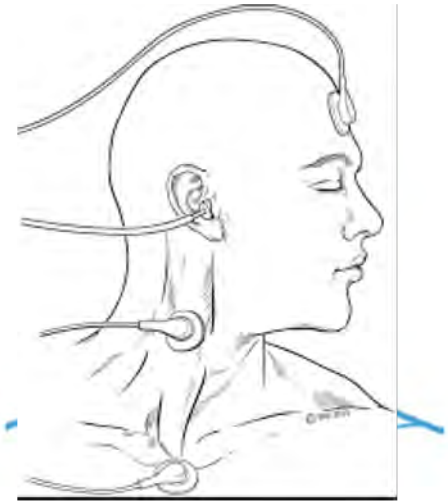
# Learning Objectives

- After this course, participants will be able to describe the patient task when collecting cVEMP and oVEMPs.
- After this course, participants will be able describe 2 differences between oVEMP and cVEMP recording.
- After this course, participants will be able to list 2 features of the GSI VEMP Anaylsis module that can assist in test interpretation.

# What is a cVEMP?

- Part of the test battery for patient's with dizziness or vertigo.
- Generated from the inner ear (saccule-in the cochlea) in response to a very *loud* sound
- Recorded from the *contracted* sternocleidomastoid (SCM) muscle.
- Amplitude of the VEMP scales in proportion to the tonic EMG activity
- Calculate the amplitude asymmetry between R/L sides

# Electrode Placement*



Active/+ : Sternal notch
Ground: Forehead
Right/- : Belly of the Right SCM
Left/- : Belly of the Left SCM

SCM = Sternocleidomastoid muscle

*P1 is downward, N1 upward

# Protocol Parameters: cVEMP

- Stimulus: 500Hz TB; 4 cycles, Blackman, Inserts
- Phase: Alternating
- Intensity: 90-95 dBnHL*
- Rate: 5.1
- Sweeps: 50-100
- Gain: *5000*
- Filters: 10-1000Hz
- Window: 50-100 msec

cVEMP Threshold: 80-85 dBnHL

# Patient Task: Optimal (SCM) Activation Technique

Stronger the contraction; larger the VEMP response


**The Effects of Amplitude Normalization and EMG Targets on cVEMP Interaural Amplitude Asymmetry**

Devin L. McCaslin, Gary P. Jacobson, Kelsey Hatton, Andrea P. Fowler, and Andrew P. DeLong

EAR & HEARING, 2013 , VOL. 34, NO. 4, 482–490

# cVEMP Amplitude with Optimal Activation Technique

**The Effects of Amplitude Normalization and EMG Targets on cVEMP Interaural Amplitude Asymmetry**

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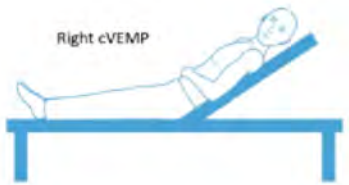


Pediatric Ages: 5-17
Young Adult Ages: 19-40
Older Adult Ages: 41-70

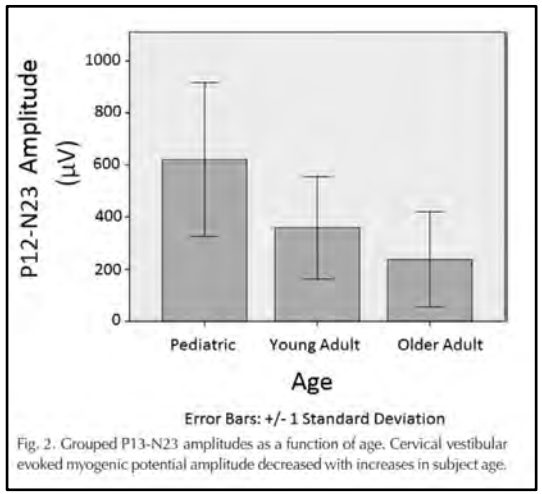


Fig. 2. Grouped P13-N23 amplitudes as a function of age. Cervical vestibular evoked myogenic potential amplitude decreased with increases in subject age.

# EMG Expected Ranges with Optimal Activation Technique

**The Effects of Amplitude Normalization and EMG Targets on cVEMP Interaural Amplitude Asymmetry**

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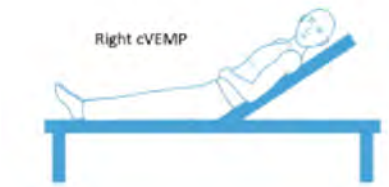
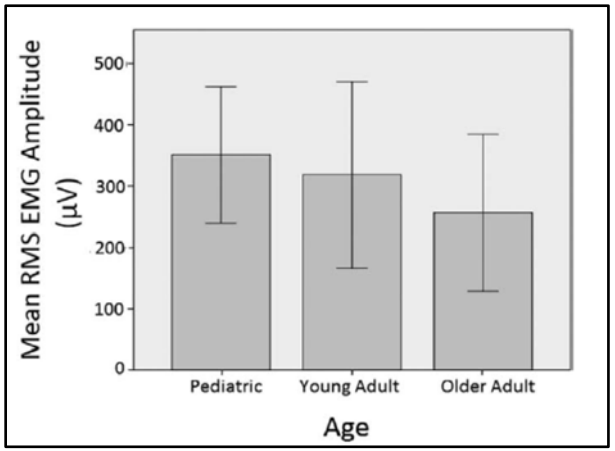
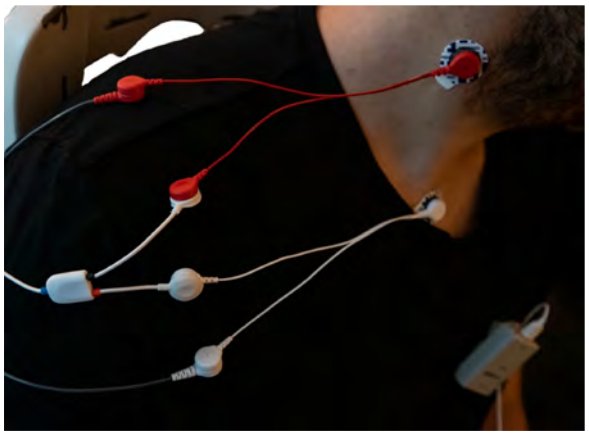
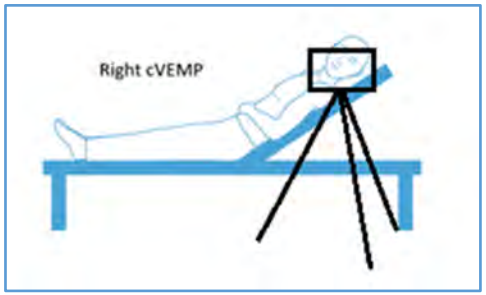


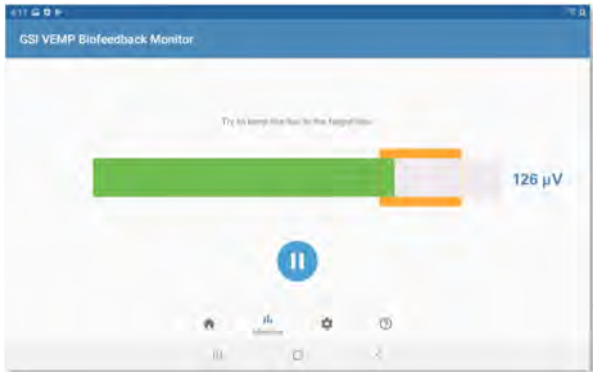

Pediatric Ages: 5-17
Young Adult Ages: 19-40
Older Adult Ages: 41-70



# GSI VEMP Biofeedback EMG Monitoring






# Step by Step

- Prepare the software
- Prepare the patient-scrub skin, apply electrodes, check impedance
- Position the patient and provide instructions:  lift and hold head off the table slightly when they hear the stimulus. (consider fatigue)
- Start the collection
- Stop the collection when a consistent waveform appears or max sweeps reached
- Replicate

# Marking Waveforms: cVEMP

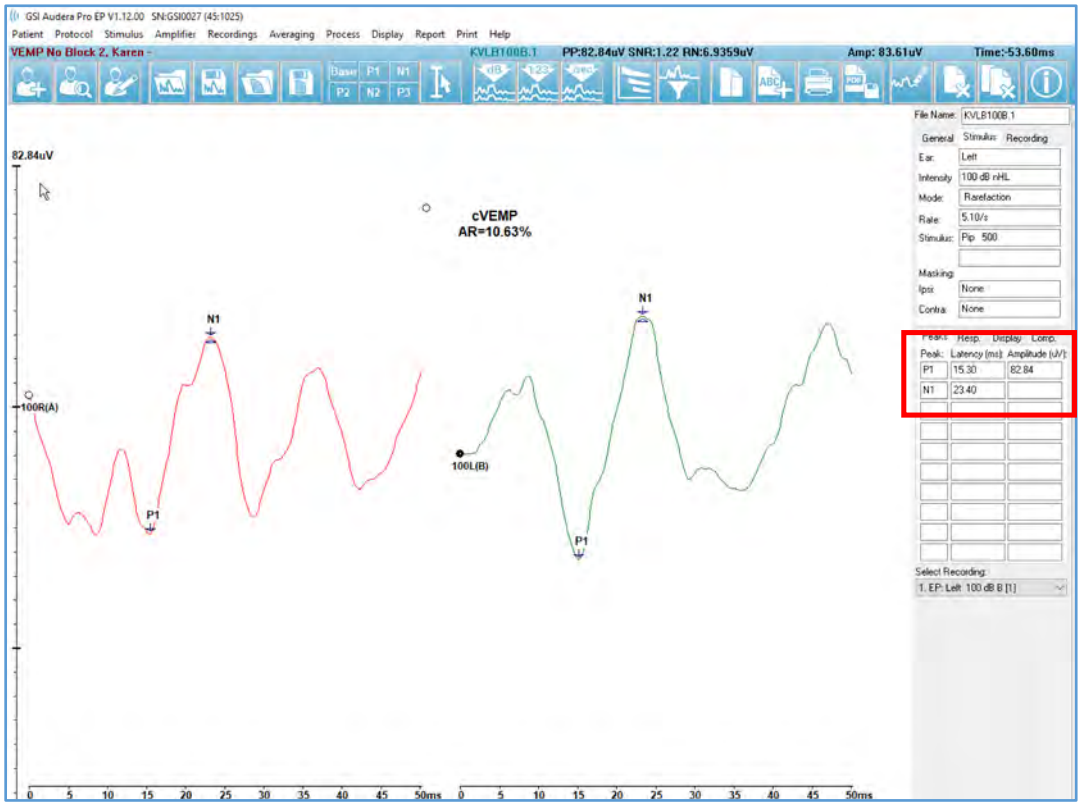
**Latency**

**P1:** 13 -20.5 ms

**N1:** 22 - 29.3 ms

**cVEMP Threshold**

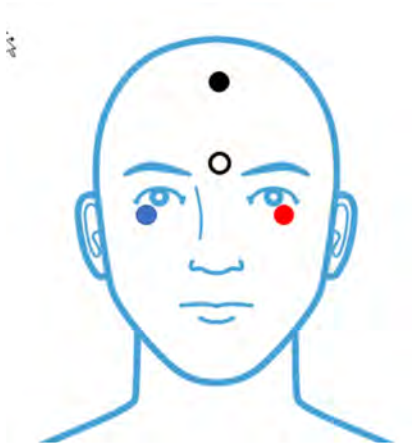
~80-85dBnHL



# What is an oVEMP?

- Part of the test battery for patient's with dizziness or vertigo.
- Generated from the inner ear (utricle/superior vestibular nerve) in response to *loud* sound.
- Recorded from inferior oblique muscle of the eye
- Recorded from the eye *contralateral* to the stimulated ear
- Calculate the amplitude asymmetry between R/L sides

# Electrode Placement



Active/+ : Low Forehead
Ground: High Forehead
Right/- : Under the Left Eye
Left/- : Under the Right Eye

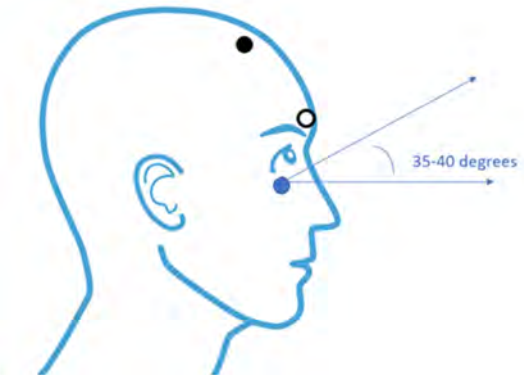
Recorded from the eye *contralateral* to the stimulated ear

# Protocol Parameters: AC oVEMPs

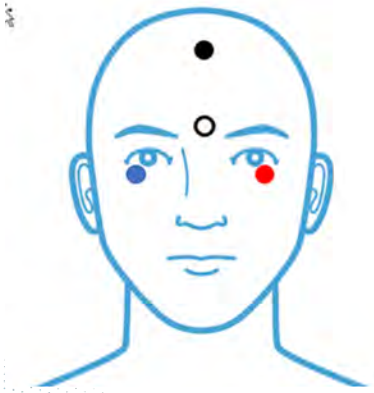
- Stimulus: 500Hz TB; 4 cycles, Blackman, Inserts
- Phase: Alternating
- Intensity: 95 dBnHL*
- Rate: 5.1
- Sweeps: 50-100
- Gain: *100,000*
- Filters: *1*-1000Hz
- Window: 50-100 msec

oVEMP Threshold: 90-94dBnHL

# Patient Task:  Look Upward




Place a spot on the wall for the patient to focus on
Relax forehead/look up with eyes only



# Step by Step

- Prepare the software
- Prepare the patient-scrub skin, apply electrodes, check impedance
- Position the patient and provide instructions:  Look upward about 35-40 degrees/gaze at spot on the wall when they hear the loud sound.
- Start the collection
- Replicate

# Marking Waveforms: oVEMP

**Latency**

N1: 10 - 12 ms

P1: 15 - 17 ms

**Amplitude*** (decreases with age)

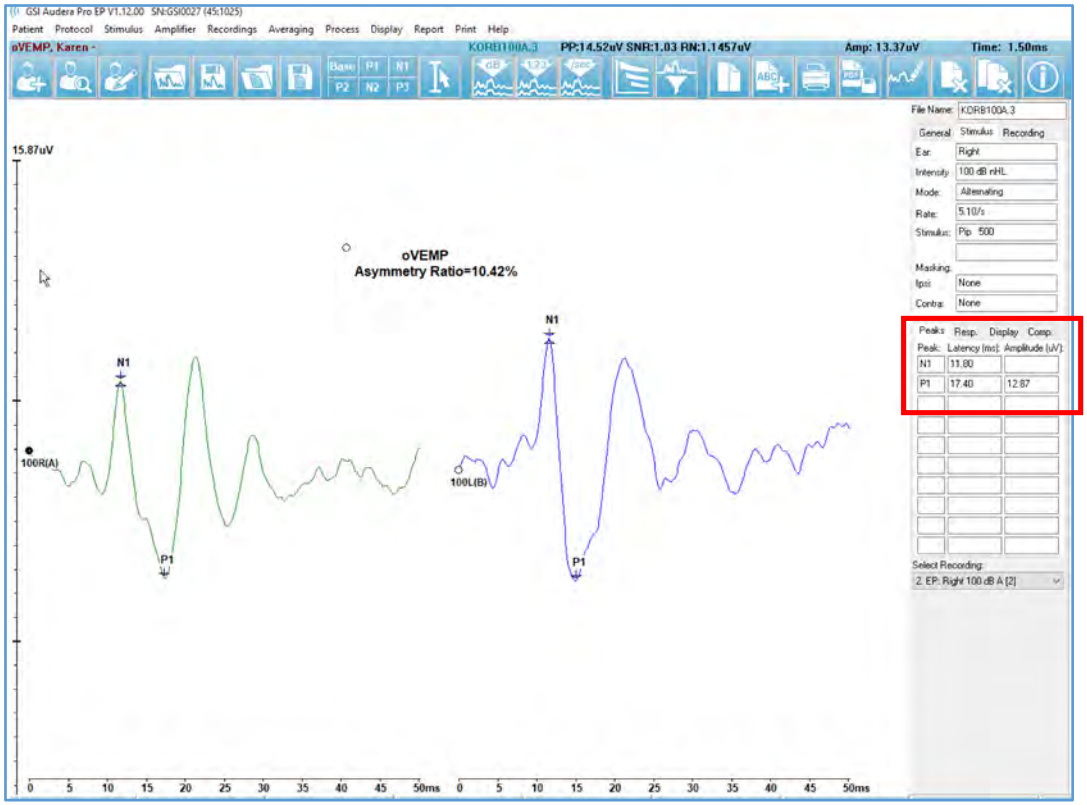
N1-P1: ~5.0 uV

(Range 1.0-25uV)

*Varies depending on study

**Threshold**

90-94 dBnHL



# How are cVEMP/oVEMPs analyzed?

- Amplitude Asymmetry Ratio (between sides)

$$\frac{\text{Right (P1/N1 amplitude)} - \text{Left (P1/N1 Amplitude)}}{\text{Right (P1/N1 amplitude)} + \text{Left (P1/N1 Amplitude)}} \times 100$$

- Amplitude asymmetry greater than 35 - 45% is considered significant (varies depending on the study.)

- Obtain cVEMP threshold if SSCD is suspected

# Causes of Absent VEMPs

1. Conductive component as minimal as 5dB can cause NR
2. Stimulus intensity is too low
3. oVEMP absence with AC stimulus; consider BC stimulation, age of patient
4. cVEMP muscle contraction is too weak (should be minimum of 30-50uV)

# References: cVEMP


- Akin, F., Murnane, O., Profitt, T. The Effects of Click and Tone Burst Stimulus Parameters on the Vestibular Evoked Myogenic Potential (VEMP). Journal of the American Academy of Audiology, 2003, 14(9), 500-509.
- Janky, K. L., & Shepard, N. (2009) Vestibular-Evoked Myogenic Potential Testing: Normative Threshold Response Curves and Effects of Age. Journal of the American Academy of Audiology, (20)8, 514-522.
- McCaslin, D.L., Jacobson, G.P., Hatton, K, Fowler, A.P., DeLong, A.P. The Effects of Amplitude Normalization and EMG Targets on cVEMP Interaural Amplitude Asymmetry. Ear & Hearing, 2013, Vol. 34, No. 4, 482-490.
- Rosengren, S.M., Colebatch, J.G., Young, A.S., Govender, S., Welgampola, M.S. (2019). Vestibular Evoked Myogenic Potentials in practice: Methods, Pitfalls and Clinical Applications. Clin. Neurophysiol Practice (4) 47-68.


# References: oVEMP


- Piker, Erin G, Jacobson, Gary P., McCaslin, Devin L., Hood, Linda. Normal Characteristics of the Ocular Vestibular Evoked Myogenic Potential. J Am Acad Audiol 2011. 22:222-230.
- Murnane, O. D., Akin, F. W., Kelly, K. J., & Byrd, S. (2011). Effects of stimulus and recording parameters on the air conduction ocular vestibular evoked myogenic potential. Journal of the American Academy of Audiology, 22(7), 469-480. doi: 10.3766/jaaa.22.7.7.
- McCaslin, D.L., Piker, E.G. A Quick Look at Ocular Vestibular-Evoked Myogenic Potentials, Audiology Today, Sept Oct 2011, p 28-35.
- Rosengren, S.M., Colebatch, J.G., Young, A.S., Govender, S., Welgampola, M.S. (2019). Vestibular Evoked Myogenic Potentials in practice: Methods, Pitfalls and Clinical Applications. Clin. Neurophysiol Practice (4) 47-68.


# VEMP *Analysis* Module


# VEMP *Analysis* Module Features

- Mark oVEMP or cVEMP Waveforms
- Automatically calculates the asymmetry ratio
- Saving automatically creates a report in the EP Module
- Rectification of cVEMP waveforms (a way to correct for asymmetrical muscle contraction using pre-stimulus EMG activity)
- Allows for viewing each sweep in a recording
- Allows for 'culling' or excluding sweeps from the grand average whose EMG activity is greater than or less than 1, 1.5 or 2 SD's

# How does it work?

- Collect VEMPs in EP module
- Open VEMP Analysis module
- Select the waveforms
- Mark N1, P1
- Asymmetry Ratio is automatically calculated

# 2021 VEMP CPT Codes*

| | | |
|---|---|---|
| 92517 | Cervical VEMP only (cVEMP) | $81.35 |
| 92518 | Ocular VEMP only (oVEMP) | $75.51 |
| 92519 | Cervical VEMP AND Ocular VEMP (cVEMP and oVEMP)* | $126.72 |

*2021 Medicare Fee Schedule for Audiologists; ASHA

# Questions

krmr@grason-stadler.com