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Simplifying Advanced Vestibular Cases, in partnership with the American Academy of Audiology

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Sara Jagger, AuD, PhD

Dr. Sara Jagger is the Director of Clinical Science and Physician Relations with the American Institute of Balance (AIB), research collaborator with the Mayo Clinic Florida, and adjunct professor for multiple universities. She was a clinical audiologist with Mayo Clinic, specializing in vestibular diagnostics and treatment as well as tinnitus and otologic disorders. Dr. Jagger coordinated patient care within an interdisciplinary continuum of care with neurotology, otolaryngology, neurology, physical therapy, and rehabilitation medicine. Prior to Mayo Clinic, Dr. Jagger was the chief medical officer for the AIB clinics and a faculty member for AIB education workshops. She obtained a bachelor's degree from Penn State, AuD from A.T. Still University's Arizona School of Health Sciences, and PhD in health sciences from Nova Southeastern University. Also, she is enrolled in the MBA program at Johns Hopkins Carey Business School.



Kim Rutherford, PT, DSc, COMT



Dr. Rutherford obtained her Master's degree in Physical Therapy (MPT) from the University of Missouri and her Doctorate of Science (DSc) in Physical Therapy from Texas Tech University. Her post-graduate doctoral work included an emphasis in education, with a specialization in orthopedic rehabilitation and a certification in orthopedic manipulative therapy (COMT). Dr. Rutherford has worked in a variety of clinical settings managing sports medicine, orthopedic, and neurological patients, in addition to administrative and academic roles. Dr. Rutherford is the Chief Operating Officer at AIB. Her role includes the evaluation, development, and management of AIB education programs. Dr. Rutherford collaborates with private, corporate, and academic organizations to deliver the most current and scientifically robust clinical information through workshops, online education, and corporate training programs.



Disclosures

- **Presenter Disclosure:** Sara Jagger Financial: Sara Jagger is employed by the American Institute of Balance (AIB) and Mayo Clinic Florida. She received an honorarium for this presentation. Sara Jagger Non-financial: Sara Jagger has no relevant non-financial relationships to disclose. Kim Rutherford Financial: Kim Rutherford is employed by the American Institute of Balance (AIB). Kim Rutherford Non-financial: Kim Rutherford has no relevant non-financial relationships to disclose.
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- Providers should always evaluate the limitations of diagnostic and screening tools, considering their potential for false results as well as any ethical implications.
- It is the responsibility of course participants to critically evaluate the evidence from multiple sources to guide professional practice.



Learning Outcomes

After this course, participants will be able to:

- Identify symptoms related to vestibular and non-vestibular causes of dizziness.
- Differentiate the principles of available vestibular tests.
- Describe effective vestibular report writing and communication with referring providers.

About Us

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 - Research Collaborator, Mayo Clinic Florida
- Kim Rutherford, PT, DSc
 - COO, The American Institute of Balance
 - MSPT, University of Missouri
 - DSc, Texas Tech University



Overview

- Key case history questions
- Two multifactorial cases
 - Six different disorders, vestibular and non-vestibular
- Report writing and communication to physicians
- Medical management potential options
- Physical therapy management



Case History

Initial attack

Length

Previous activity

Single or multiple episodes

Associated symptoms

Current symptoms

Provoking factors

Symptom improvement

Medications and medical history

Vestibular Tests

Videonystagmography (VNG)

- Horizontal canal
- BPPV

Rotational Chair

- Horizontal canal

Video Head Impulse Test (vHIT)

- All 6 semicircular canals

Cervical Vestibular Evoked Myogenic Potentials (cVEMP)

- Saccul and inferior VN

Ocular VEMP (oVEMP)

- Utricle and superior VN



Some other helpful tests

Ambient Pressure Tympanometry

Cervical dizziness tests



Case 1

- 38-year-old male
- Prolonged episode of vertigo, lasting 2-3 hours one year ago
- No otologic or focal neurologic symptoms
- Went to VRT
- PT helped with oscillopsia symptoms

Case 1: Medical History

- Medical history includes migraine (most recent was years ago), anxiety, and controlled hypertension
- Pharmacologic regimen: Tramadol nightly for sleep, diazepam daily for anxiety, and atenolol for blood pressure

Case 1: Physical Therapy Evaluation

PT Referral from PCP: "Evaluate and Treat", no diagnostic testing or medical work up

Diagnosis: R42 Dizziness and Giddiness

Bedside Testing: Evaluation	Results
Gaze Testing/HIT	Negative
DVA	Negative: Horizontal Plane Positive: Vertical Plane
Dizziness Handicap Inventory	74/100
Postural Stability Testing (mCTSIB)	Abnormal Sway noted with all 4 conditions (no fall), reports subjective dizziness throughout, primarily with EO conditions
OPK	Subjective reports of dizziness (9/10) with testing No asymmetry noted
Strength/ROM/Mobility	Within Normal Limits throughout except 25% decrease in Cervical Range of Motion
Functional Testing (Sit to stand, Timed Get up and Go, Motion Sensitivity Quotient)	Grossly limited by 50% due to reports of dizziness throughout (7/10)



Case 1: Physical Therapy Management

- UHC approved 6 total visits
- Visit one: Evaluation only, patient unable to tolerate intervention
- Remaining 5 visits:
 - **VRT: focusing on:**
 - Oscillopsia: Adaptation Exercises for Gaze Stabilization in the Vertical Plane
 - Visual Vestibular Integration: Habituation exercises with graded exposure to complex visual stimulus
 - **Cervical Spine mobility issues:** soft tissue and joint mobilization, focusing on restoring patient's ROM
 - **Functional Deficits:** general balance and strengthening activities within patient tolerance levels
 - Limited focus due to patient's tolerance level and high degree of perceived disability



Post Therapy Outcomes

Bedside Testing: Reevaluation	Results
Gaze Testing/HIT	Negative (Initial: Negative)
DVA	Negative (Initial: Positive in Vertical Plane)
Dizziness Handicap Inventory	72/100 (Initial: 74/100)
Postural Stability Testing (mCTSIB)	Abnormal Sway noted with all conditions (no fall), reports subjective dizziness throughout with both EO and EC condition (Initial: EO)
OPK	6/10 dizziness reported (Initial: 7/10)
Strength/ROM/Mobility	WNL throughout (Initial: C-spine limitations noted)
Functional Testing	Unchanged

Next Steps?

- **PT Referral Back to PCP**
 - Patient has "plateaued"
 - Organic (Physical/Biological) vs Non-Organic impairments (Anxiety)?
 - Measurable Improvement
 - Strength/Mobility assessment: Normal, Cervical Spine is clear
 - No measurable or reported Oscillopsia
 - Unchanged/Unremarkable Improvement:
 - DHI
 - Functional Testing
 - Postural Stability
 - **OTHER:** Insurance constraints



Case 1: Current Symptoms

- Consistent unsteadiness daily lasting hours to all day since onset of vertigo
- Symptoms occur when standing and/or moving and worsen with visual stimulation
- Significant social isolation and decreased quality of life
- Unremarkable neurology, cardiology, and internal medicine evaluations.



Case 1: Vestibular Test Results

- Cervical VEMP: 51% right unilateral weakness
- Computerized Dynamic Posturography (CDP): Abnormal for all conditions; however, patient does not fall. She can perform conditions 5 and 6 once out of three trials.
- Calorics, oVEMPs, rotary chair, SVV, vHIT of all canals, and oculomotors were all within normal limits.

3. Criteria for the diagnosis of Persistent Postural-Perceptual Dizziness (PPPD)

PPPD is a chronic vestibular disorder defined by criteria A-E below. All five criteria must be fulfilled to make the diagnosis.

- A. One or more symptoms of dizziness, unsteadiness, or non-spinning vertigo are present on most days for 3 months or more.¹⁻³
 - 1. Symptoms last for prolonged (hours-long) periods of time, but may wax and wane in severity.
 - 2. Symptoms need not be present continuously throughout the entire day.
- B. Persistent symptoms occur without specific provocation, but are exacerbated by three factors:^{4,5}
 - 1. Upright posture,
 - 2. Active or passive motion without regard to direction or position, and
 - 3. Exposure to moving visual stimuli or complex visual patterns.

- C. The disorder is precipitated by conditions that cause vertigo, unsteadiness, dizziness, or problems with balance including acute, episodic, or chronic vestibular syndromes, other neurologic or medical illnesses, or psychological distress.⁶
 - 1. When the precipitant is an acute or episodic condition, symptoms settle into the pattern of criterion A as the precipitant resolves, but they may occur intermittently at first, and then consolidate into a persistent course.
 - 2. When the precipitant is a chronic syndrome, symptoms may develop slowly at first and worsen gradually.
- D. Symptoms cause significant distress or functional impairment.
- E. Symptoms are not better accounted for by another disease or disorder.⁷

Case 1: PPPD Recommendations

- SSRIs and SNRIs have been shown to help reduced symptoms by 60-70%
- Vestibular/balance rehabilitation therapy can help.
- Cognitive Behavioral Therapy (CBT)



Report Writing

- Remember your audience
- Be clear and concise
- Answer the following questions:
 - Is there peripheral vestibular evidence?
 - Is there central vestibular evidence?
- Provide appropriate recommendations



Case 1: Report Writing

- Compensated Unilateral Vestibulopathy: Findings are remarkable for right vestibular dysfunction affecting the saccule and/or inferior vestibular nerve as evidenced by asymmetric cVEMP. Normal rotational chair gain, vHIT, and SVV results suggest that the patient is compensated.
- Suspected Persistent Postural Perceptual Dizziness (PPPD): Reported symptoms causing functional impairment and distress including dizziness, unsteadiness, or non-spinning vertigo that occurs most days for hours at a time and > 3 months with exacerbation by upright posture, active or passive motion, and moving or complex visual stimuli are suggestive of PPPD, if other medical disease or disorders are rule out. The pattern of postural stability on Computerized Dynamic Posturography is not pattern-specific and may be associated with PPPD.



Case 1: Communicating Results

- More advanced cases and less common/known diagnoses, should be communicated verbally as well as through the report
- Call, message, email, whatever means necessary
 - Best times to call are usually first thing in the morning before clinic, just after lunch before clinic, or end of the day
- Be ready to send articles
- Increasing good communication with providers can significantly increase their referrals to your practice



Case 1: Outcomes

- Fluoxetine (Prozac) and restarted VRT
 - Focus in VRT became high level activities
- Cognitive Behavioral Therapy (CBT)
- Following 8 weeks of the SSRI, VRT, and CBT, he was feeling 90% better



Case 2

- 56-year-old male
- Fell off a 20-foot extension ladder onto grass
- Believes that he lost consciousness for only a few seconds
- Immediate onset headache, dizziness, imbalance, neck pain, nausea, confusion
- Went to ED – CT scan unremarkable, diagnosed with concussion

Case 2: Medical History

- Medical history includes high cholesterol and prediabetes
- Pharmacologic regimen: Lovastatin for cholesterol



Case 2: Current Symptoms

- Ongoing headaches, 5-6/10 is baseline, can reach 10/10
- Nausea that increases with movement
- Photophobia
- Phonophobia
- Dizziness – internalized sensation of spinning, worse with head movement
- Pulsatile tinnitus – left ear
- Aural fullness – left ear
- Autophony – left ear
- Confusion and disorientation
- Ataxic gait
- Sleep issues
- Increased irritability
- Speech is slurred
- Neck pain
- Head feels heavy



Case 2: Symptom Separation

Cortical Concussion Symptoms	Post-traumatic headache/migraine	Audio-Vestibular Symptoms	Cervical
Confusion and Disorientation	Headaches	Pulsatile tinnitus	Neck pain
Ataxic gait	Photophobia	Autophony	Head feels heavy
Sleep Issues	Phonophobia	Ear fullness	Dizziness
Increased Irritability	Dizziness	Dizziness	
Slurred speech			



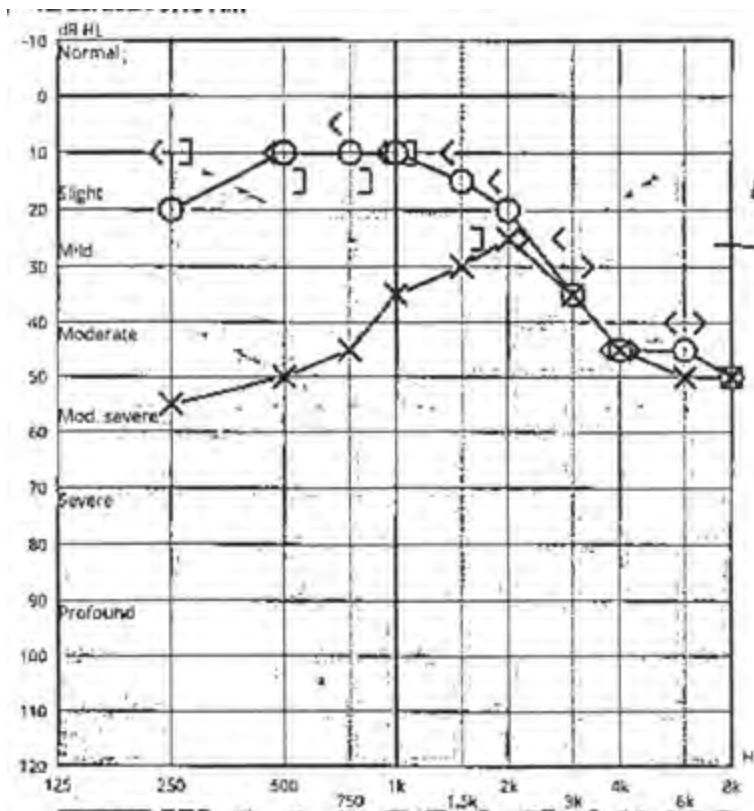
Case 2:

Vestibular Testing mCTSIB

- Modified CTSIB: Normal for conditions 1 and 3 (eyes open), sway on condition 2 (eyes closed), fall on condition 4 (eyes closed on foam)

Case 2: Audiogram

- Mixed left ear hearing loss with low frequency conductive component



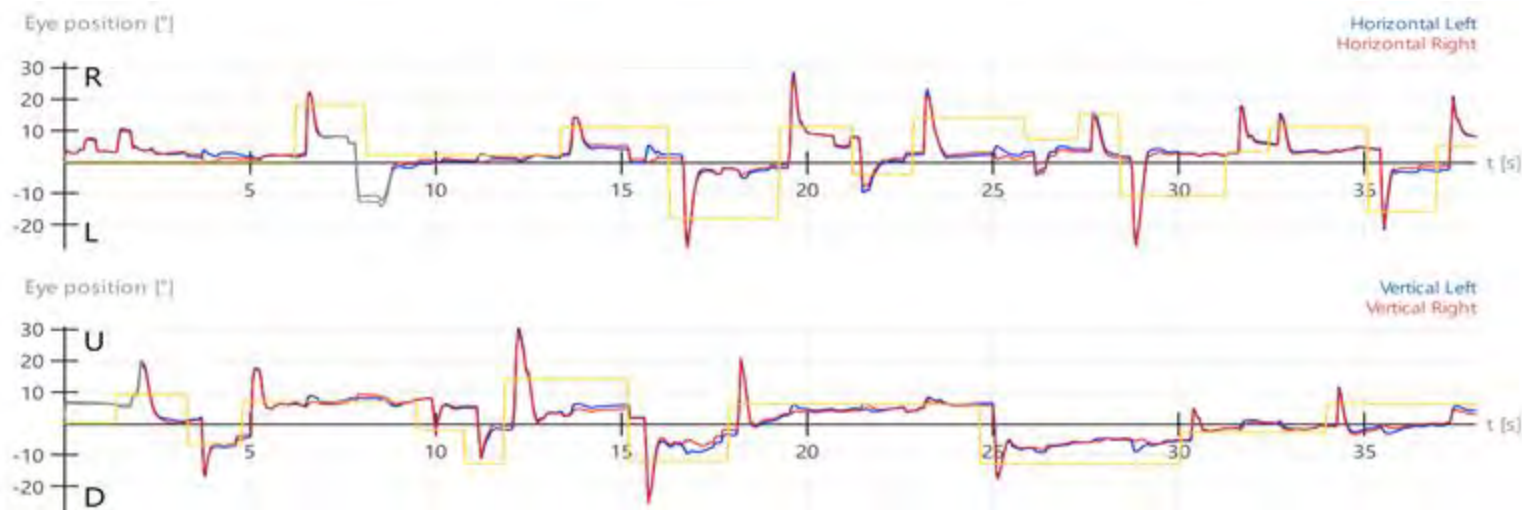
HEARING HEALTH HISTORY

Y N Do you have hearing loss? *so they say*

If yes: Which ear? right ear, left ear, both ears (circle one)

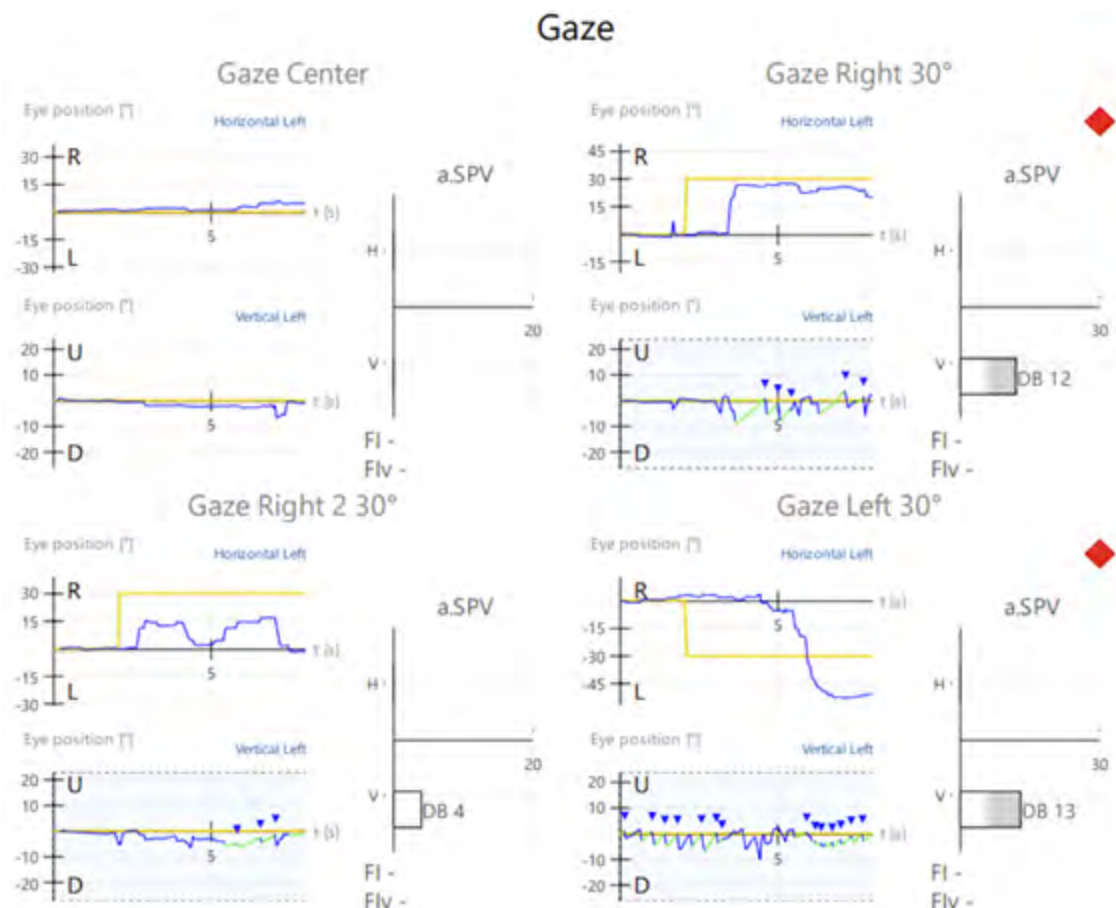
Case 2: Saccades

- Hypermetric responses



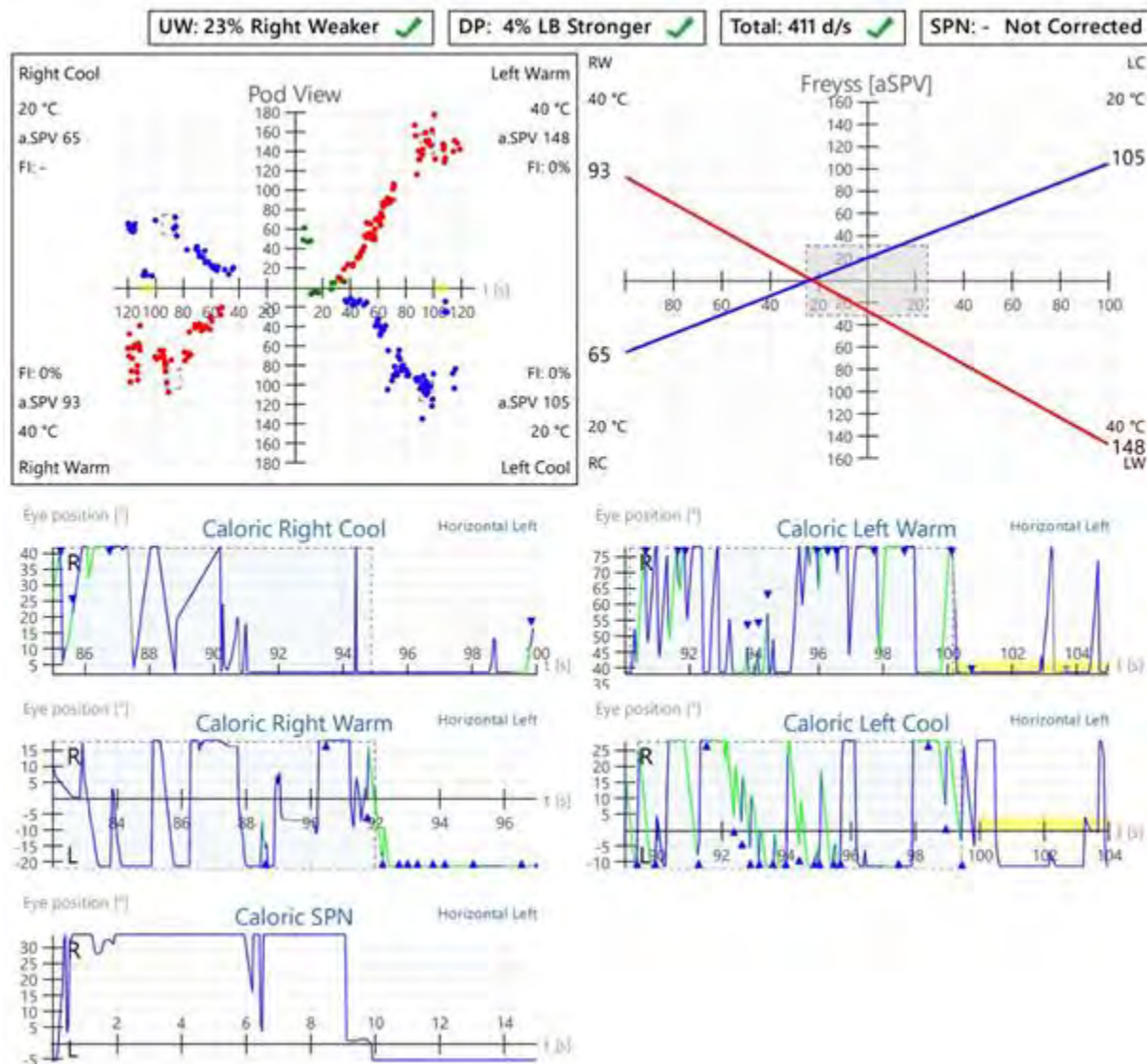
Case 2: Gaze

- Downbeat nystagmus



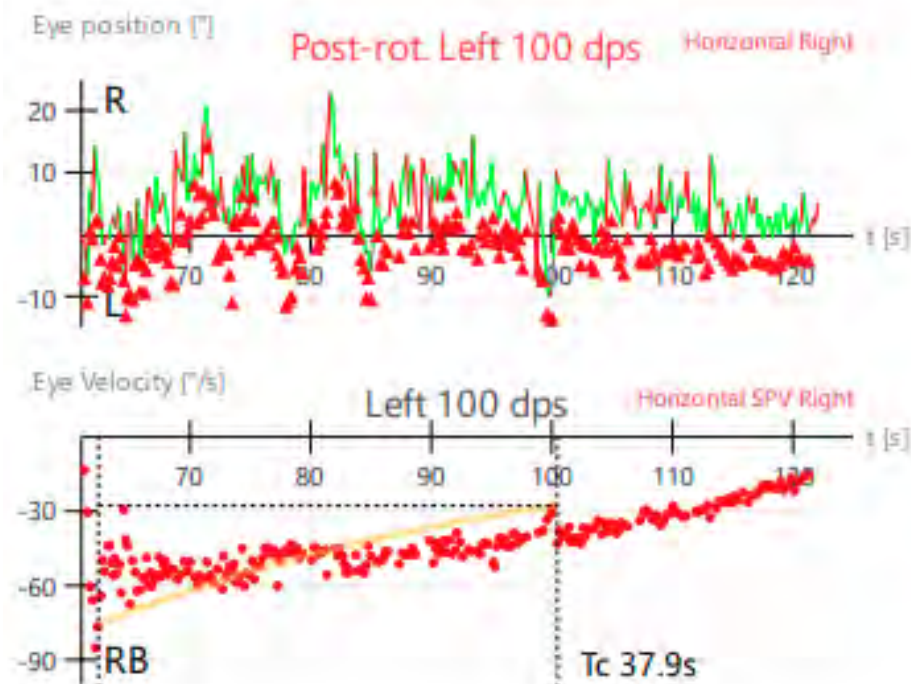
Calorics

- Hyper responses



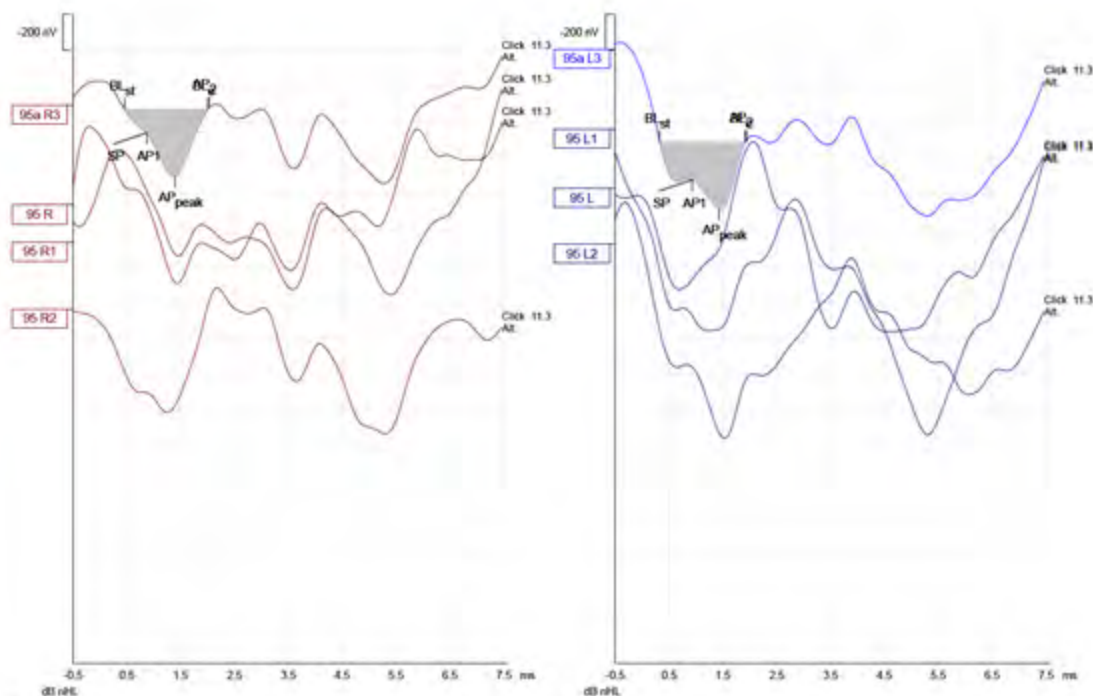
Rotary Chair

- Long time constants on step velocity test



Case 2: ECochG

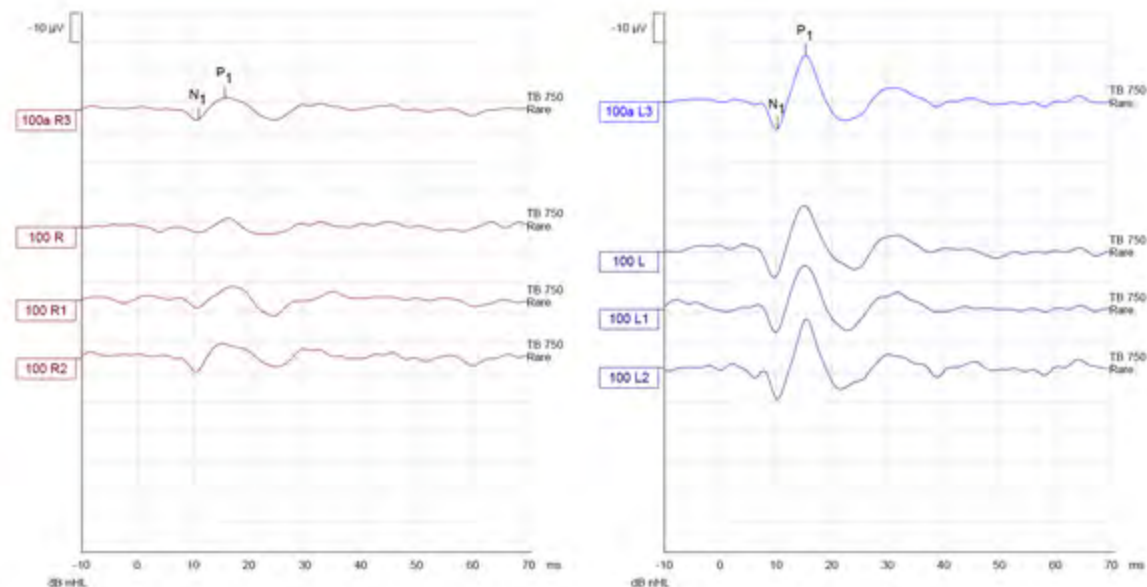
- ECochG:
Large SP/AP
ratio (0.566)
and area
under the
curve (2.367)



Curve	Latencies (ms)							
	SP Amp	SP Area	SP Dur	AP Amp	AP Area	AP Dur	SP/AP Area	SP/AP Amp
95 R								
95 R1								
95 R2								
95 L								
95a R3	0.131	8.666	0.40	0.370	5.697	1.17	1.521	0.354
95 L1								
95 L2								
95a L3	0.210	10.76	0.60	0.370	4.547	1.00	2.367	0.566

Ocular VEMP

- Large left amplitude (24.77)
- Normal right amplitude



Curve	Latencies (ms)						
	P1	N1	P1'	N1'	N1-P1 Lat	N1-P1 Amp	(LA-SA)/(R+L)
100 L							
100 L1							
100 L2							
100a L3	15.33	10.33			-5.00	24.77	0.54
100 R							
100 R1							
100 R2							
100a R3	15.67	11.00			-4.67	7.371	0.54

SSCD

Symptoms

- Tulio effect
- Hennebert effect
- Autophony
- Pulsatile tinnitus

Signs

- Evoked nystagmus
- Enlarged VEMP
- Pseudo-conductive hearing loss with present acoustic reflexes



Ambient Pressure Tympanometry

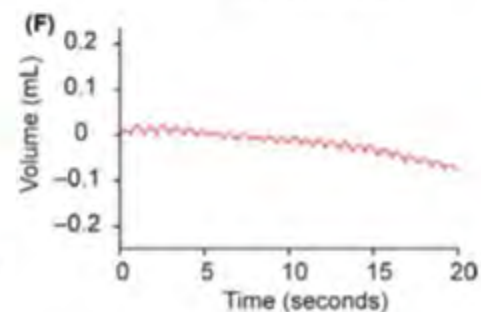
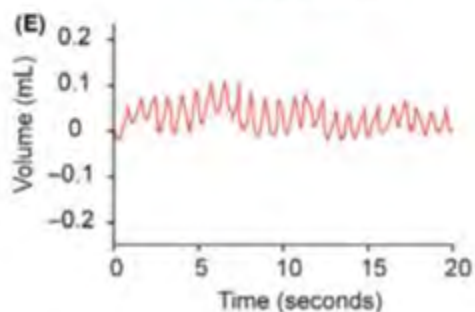
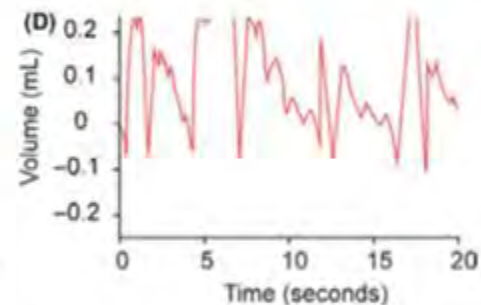
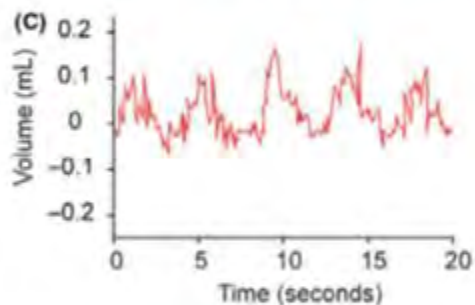
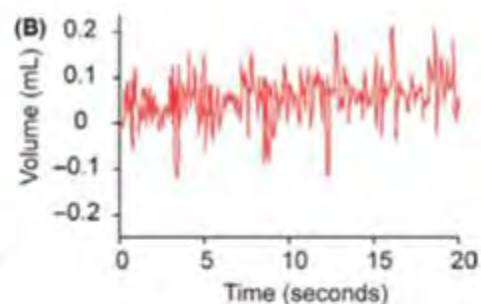
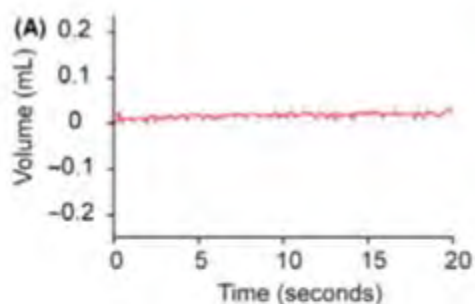
- A measure of TM compliance without external pressure changes
- Sensitive to:
 - Pulsatile tinnitus
 - Autophony
 - Semicircular canal dehiscence
 - Glomus tumors
 - Cholesteatomas
 - Sigmoid sinus diverticulum/dehiscence
 - Patulous Eustachian tube
 - Middle ear myoclonus



Normal APT

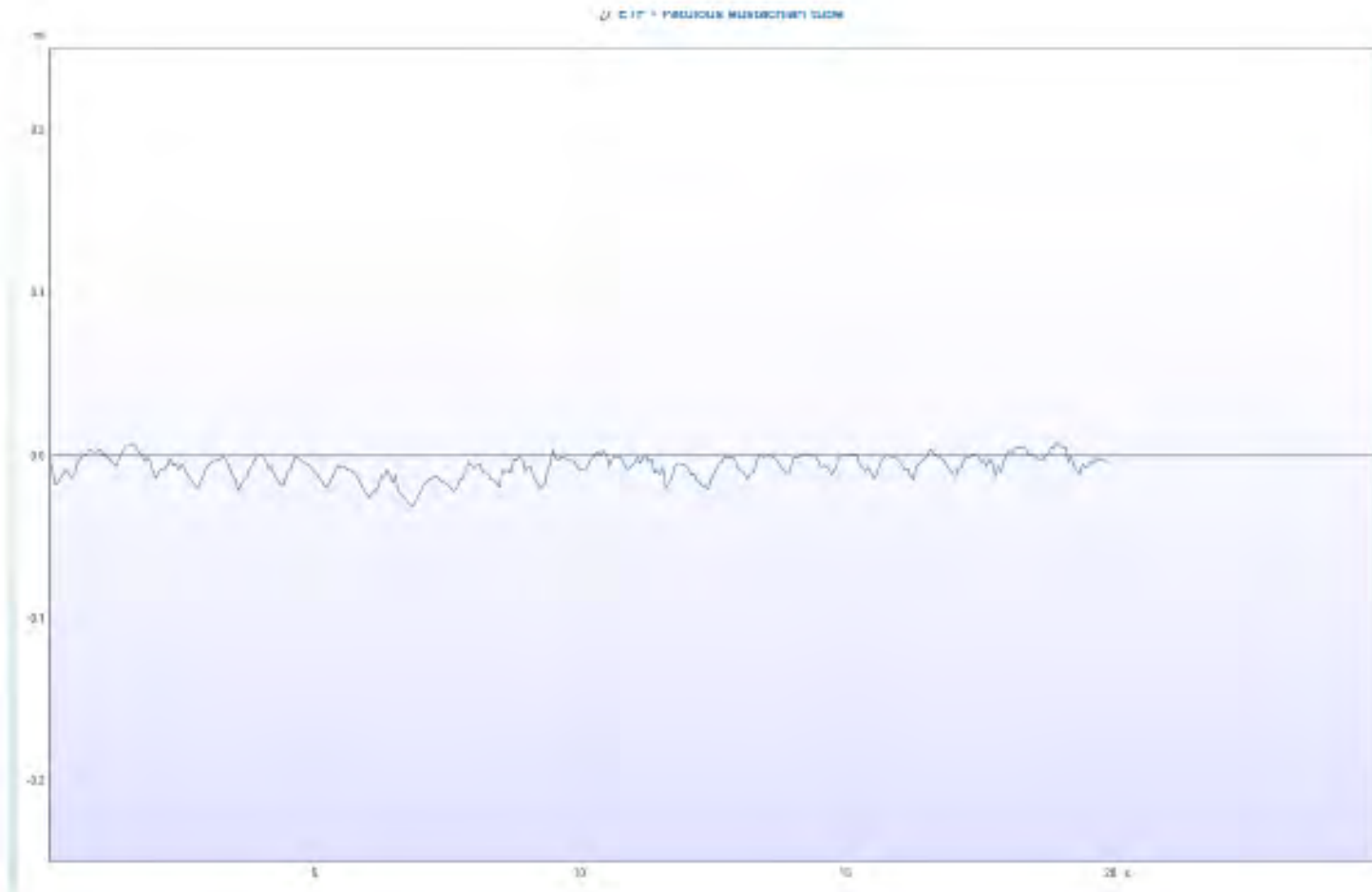


Abnormal APT





Case 2: APT





Case 2: Post-Traumatic Headache

5. Headache attributed to trauma or injury to the head and/or neck

5.1 Acute headache attributed to traumatic injury to the head

5.1.1 Acute headache attributed to moderate or severe traumatic injury to the head

5.1.2 Acute headache attributed to mild traumatic injury to the head

5.2 Persistent headache attributed to traumatic injury to the head

5.2.1 Persistent headache attributed to moderate or severe traumatic injury to the head

5.2.2 Persistent headache attributed to mild traumatic injury to the head

<https://ichd-3.org/5-headache-attributed-to-trauma-or-injury-to-the-head-andor-neck/>

Case 2: Report Writing

1. Central Vestibular Indicators: Findings including hypermetric saccades, downbeat nystagmus, caloric hyper response, and prolonged time constants on rotary chair are central vestibular indicators specific to the cerebellum. Clinical correlation recommended.
2. Suspected Post-Concussive Symptoms: Reported symptoms suggest that post-concussive disorder cannot be ruled out. Recommendations may include a multidisciplinary approach.. Physical therapy may be one management approach including vestibular rehabilitation therapy and cervical assessment. Therapy is most beneficial if headache symptoms are medically managed. Speech therapy may be also useful for slurred speech concerns.
3. Suspected Third Window Pathology: Enhanced ocular VEMP amplitude suggest a left semicircular canal dehiscence or other third window pathology. Recommendations include correlation of results and symptoms with high resolution CT scan of the temporal bones and/or medical evaluation.
4. Otherwise Unremarkable Peripheral Vestibular Findings: No clear evidence of peripheral vestibular involvement other than suspected third window disorder.



Case 2: Physical Therapy Intervention

- Referral to PT **post** medical work up
 - Diagnosis: M54.2 (Cervicalgia), Headache (R51.9), Imbalance (R29.3)
- **Primary presentation:**
 - Neck pain with occasional dizziness with head movement
 - Headache: evening>day
 - Unsteady when walking on uneven surfaces: evening>day



Physical Therapy Evaluation

Evaluation	Results
Post Concussion Symptom Scale (1-6 grading scale of most common symptoms post head trauma)	5/6 score for Headache
Comprehensive Cervical Evaluation	Joint restriction, soft tissue restriction, and muscle weakness. Pain rating 7/10. + Cervical Torsion Test
Aerobic Capacity Assessment	Assessed exercise tolerance threshold, used to guide prescriptive safe level of exercise to enhance recovery post head trauma (HR, subjective scale)
Strength Assessment	Decreased lower body/trunk strength
Postural Stability Testing: BESS Testing	Score: 44/60 Primary deficits on uneven surfaces (EC>EO)



Physical Therapy Management

- Patient seen for 2x/week for 4 weeks (8 visits)
- Management strategies included:
 - Cervical joint and soft tissue mobilization
 - Cervical strengthening
 - LE/core strengthening
 - Prescriptive aerobic activity within patient HR/symptom threshold
 - General balance training, focusing on negotiating uneven surfaces
 - Patient Education: rest/recovery, symptom management



Physical Therapy Outcomes

Re-evaluation	Results
Post Concussion Symptom Scale	0/6 Headache
Comprehensive Cervical Evaluation	Full Range of Motion, pain 1/10 with prolonged sitting (Initial: 7/10) (-) Cervical Torsion Test
Aerobic Capacity Assessment	Discharged to pre-injury aerobic activity
Strength Assessment	LE/trunk strength restored to function
Postural Stability Testing: BESS Testing	Error score 18/60 (Initial: 44/60)



Summary

- ***Multi-disciplinary Approach***
 - Testing Protocol helps best quantify a patient's impairments, in turn leading to individualized management strategies
 - Improved efficiency in therapy=less visits required
 - Improved patient experience and outcomes
 - Referral Relationships!

Thank You!

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