Visual Considerations of Dizziness, Vertigo and Imbalance
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Disclosure Statement:
Nothing to Disclose

Introduction
- Third most common complaint among outpatients
- 5/1000 consult PCP annually for vertigo
- 10/1000 consult PCP for dizziness
- 80% severe enough to necessitate intervention
- 40-80% are unexplained by PCP…visually related?
- >50% of elderly population affected
- Most common complaint for visits in >75 yr olds

Chief Concern–FALL PREVENTION

What Kind of Patient Might Benefit?
- 64yo male, R Pontine ischemic CVA, L weakness
- Initially denied dizziness during Physiatry consult
- Recommended OT, PT, Speech for past two weeks
- Neuro-Optometric consult requested as he now notes vision concern, but no diplopia or VF concerns
- During Hx mentions dizzy in AM upon awakening
- Dynamic VA testing indicated 2 line decrease, wearing his +50 at distance was a single line
- Recommended vestibular input upon awakening, referral to PT Vestibular Rehab, F/U next week

Who is Helping With What?
- Medical Concerns - Evaluation and Treatment
- Physical/Occupational Therapy
  - Functional Motor Skills, often includes balance therapy
  - Vestibular Rehabilitation including eye movements
- Neuro-Optometric Rehabilitation (NOR)
  - Visual Rehabilitation including effects upon vestibular rehabilitation and mobility
  - So what’s so special or different?
  - Central/Peripheral and Reciprocal Interweaving
- Multi-Disciplinary Approach provides better info!
### Overview of Dizziness and Balance Disorders

- Intimate relationship between visual, vestibular and motor processing
- Health Concerns
- Medication Concerns
- Trauma, CVA and Neuro Concerns
- Evaluation
- Treatment
- Follow-up

### Balance and Imbalance

- Motor – general, cervical
- Visual – central vs. peripheral vs. fixations
  - Where do you look during ambulation?, etc.
- Vestibular – address bppv, then habituation tx
- Integration–occurs within CNS, meds ?
- Without integration, primarily 'substitute' other input to maintain homeostasis of balance
- Cerebellum–modulates processes as well

### Functions of Vestibular Processing

- Arousal and Calming–in a car
- Extensor Tone–against gravity and flexion
- Cocontraction–balance of flexion/extension
- *Equilibrium Responses–cerebellum
- *Gravitational Security–integration of reflexes

### Vestibular System

- Peripheral Vestibular System
  - Semicircular Canals – rotational input, phasic
    - Stimulatory–Arousal
  - Otoliths – linear input, tonic
    - Calming
  - Do these really ever work in isolation?
- Central Vestibular System
  - Unilateral vs. Bilateral concerns

### Functions of Vestibular Processing

- Bilateral Coordination
  - Reciprocally related to vision and motor
- Eye Movements
  - Sets tone for EOM, low tone and CI
- Stability for visual information processing
  - Feedback for stability of head and body, thus allowing cognition to be free of postural control
Vestibular Physiology

Semicircular Canals - Otoliths

Semi Circular Canals - Stimulation

SCC Input to EOM's

Redrawn from Ito M, Kita T, Yamamoto M. Pathways for the vestibulo-ocular reflex excitation arising from semicircular canals of rabbits. Exp Brain Res. 1996;110(1):57-77. With permission of Springer Science and Business Media and the authors.
Visual Motion, Vestibular, Cervical

- Head-Static – movement in the visual field may lead to motion hypersensitivity (linear vs. optic flow)
- Head-Dynamic –
  - Vestibular - Linear vs. Rotational
  - Visual – Fixation vs. Peripheral Lock
  - Visual Motion – linear vs. optic flow
  - Proprioception - Cervical vs. Torso Component vs. Other

Vestibular vs. Motion Sensitivity

- VOR gain = head vs. eye movement, should = 1.0
- Includes Subcortical and Cortical components
  - Includes VOR, OKN, pursuits, saccades, fixation
  - Blinking during movement eliminates motion
  - Peripheral vision provides lock for fusion and stability
  - Saccadic suppression mechanisms work by dampening motion, and then reset with fixation

Importance of VOR Gain in ABI

- Born with a primarily subcortically driven gain of 1.0
- By 6-9 months the cortical control of fixation, pursuits and motion processing/OKN are coming along
- Gain of 1.0 at this time = SC of 0.6, Cortical of 0.4, but this relationship ‘varies’ throughout the day
- Following ABI, gain is often <1.0 resulting in blur and motion awareness
- To make up for this you can consider vestibular rehabilitation, low plus/less minus, visual skill therapy

Etiologies of Dizziness

- Peripheral Vestibular System
  - Semicircular Canals, Otoliths
- Central Vestibular System
  - Processing of inputs
- Central Nervous System
- Vascular Changes
- Visual Pathway
- Cervicogenic
- Differentiating Etiology and Treatment

Challenges in Overcoming Dizziness

- Cognitive Overload in Attempt to Compensate
- Example – lawyer addressing jury
- Abstain from Movement
### Tests of Dizziness, Gait and Balance

- Dizziness Handicap Inventory (DHI)
- Romberg and Sharpenerd Romberg test
- Hallpike-Dix Maneuver (brpsv)
- Posturography, Electronystagmography (ENG)
- The Clinical Test for Sensory Interaction in Balance
- The Tinetti test (POMA-Performance-Oriented Mobility Assessment)
- The Berg Balance Scale, The ‘Get Up and Go’ test
- ‘Five Times Sit to Stand’ test, ‘Four Square Step’ test
- The ‘Stops walking when talking’ test
- Others

### Examples of Precipitating Factors

- Monovision
- Diplopia
- Inability to compensate for hyperopia and/or decrease in VOR gain
- Changes in medications
- Orthostatic hypotension-BP drops suddenly
- Others…

### Posturography

### Optometric Assessment

- Case History
- Observations
- Clinical Testing
  - Routine visual examination
  - Ocular motor examination
  - Disequilibrium Evaluation Form
    - This can lead toward “substitution” guidance
  - Special Testing

### Disequilibrium Evaluation Form

- Determine level of dizziness and motion sensitivity with provocative testing
- 1-Head (vestibular-visual motion) vs. Ocular-Motor (visual motion)
  - Spontaneously move eyes vs. move head ?
  - Blink during saccades ? Head movement ?
- 2-Static Posture – sitting vs. standing
- 3-Dynamic Posture – walking, including turns
- Scale 0(no dizziness) to 10(not tolerable)

### Disequilibrium Evaluation Form

- Head Movement – L to R, R to L
- Ocular-Motor Movement – L to R, R to L
- Sitting
- Standing
- Stand and Turn R, Stand and Turn L
- Walking
- Walk and Turn R, Walk and Turn L
- Substitution – Feel Feet, Visual Fixations, Touch
Special Testing

- Dynamic Visual Acuity
  - Check static VA, rotate head 2 hz, Drop of 2-3 lines suggests vestibular defect (what if 1?)
- Head Thrust Test
  - Quickly shift head R and L, refixation saccade suggests decreased VOR
- Head Shaking Nystagmus
  - Head down 30 degrees, oscillate head 20X
  - Resultant jerk nystagmus indicates unilateral vestibular imbalance

Dizziness/Vertigo Management

- Spontaneous Recovery
  - Integration improves to overcome symptoms
- Adaptation
  - Resilience – including other factors
  - Symptoms may return later when other demands increase and the patient has to divide attention, resulting in loss of control of dizziness (ie-decompensating phoria)

Movement Needed to Recover

![Diagram](image)

Dizziness/Vertigo Management-Traditional

- Vestibular Rehabilitation
  - Repositioning-for BPPV
    - Dix-Hallpike, Epley, Brandt-Daroff Maneuver
    - Exercises as well
  - Substitution
  - Habituation
  - Eye Exercises
- Medical Treatment
  - Medication
  - Surgery

Benign Paroxysmal Positional Vertigo

![Diagram](image)

BIG Picture in Treatment

- Address BPPV Positioning if true vertigo
- Habituation Therapy (vestibular component)
- Eye Movement Therapy (to decrease the visual motion component)
- Functional Mobility – many motor aspects
- *Substitution may be a missing KEY?
  - For recovery to occur, you must have some baseline ability to recover or reduce symptoms
Dizziness Course for PT’s

“It’s an injustice to NOT overstimulate your patient, because your goal is to make their daily life as normal as possible.”

What does this really mean?
1-How do you cope or recover from the increased symptoms?
2-Assumes a “No Pain, No Gain” attitude

Dizziness/Vertigo Management

Neuro-Optometric Rehabilitation (NOR)
- Much more than “orthoptics” – no head movement!
- Visual considerations of central/peripheral, blinking, substitution, habituation
- Lenses-watch progressives, multiple pairs, low plus a valuable tool, Aniseikonia (Shaw Lens), CL’s
- Prism – to stabilize binocularity, low base in
- Selective Occlusion – binasal
- Basic Binocular and Visual Skills

Key Points in Treatment

- Spontaneous Adaptation needs movement
- Gaze Stabilization needs movement to recover, patients often decrease movement (avoidance)
- Gain of VOR needs to be 1.0 (ABI changes?)
  - Habitation therapy likely modifies VOR gain
  - Increase gain with EOM therapy-pursuits, saccades
  - Increase VOR gain with low plus, magnification
- KEY – Must learn to control symptoms in order to be successful in treatment (scale 0-10) AND improve VOR gain

The BIG Picture in Treatment

- Dysequilibrium scores of 4 or greater need to introduce substitution skills to learn to control symptoms before beginning rehab (goal=3)
- Otherwise if you treat, they may not know how to recover from the stimulation, some get worse
- This mandates multi-disciplinary care with other providers such as physical therapists
- Visual considerations (lenses, NOR therapy) are often the missing link to rehabilitation

Optometric Case Examples

- Compensatory - eliminate the perturbation
  - Stop moving, occlusion, others?
- Substitution and Guidance
- Habitation-Gaze Stabilization Therapy
- Lens and Prism Considerations (Binoc and BI)
- Binasal Occlusion
- Binocular considerations
- Basic Visual Skill therapy

Substitution - Motor

- Touching wall, walking heavily, rub R finger thumb vs. L/both
- Provide a cane, weights, shopping cart
- Cervical – touch neck, scarves, hoodies, turtlenecks
- Miscellaneous – Phiten Necklaces
Cane / Pole, Weights (vest)

Substitution - Visual
- Peripheral awareness vs. being overly central
- Blinking during saccades, or head turns
- While turning corner, add fixations or blink
- Driving considerations – use of mirrors
- Hat, side shields or tints to reduce contrast and thus also motion
- Binasals, low plus, low base in prism
  *KEY is trial them!

Effects of Hat, Side Shields
- Decreases Symptoms
  - Visual Motion Hypersensitivity
  - Photosensitivity - fluorescents
  *Proprioceptive Dependent
- Increases Symptoms
  - Vestibular Concern
  *Visually Dependent

Visual Fixations During a Turn vs. No fixations

Disequilibrium Evaluation Example
- Head Movement – worsens with head movement
- Ocular-Motor Movement – blinking helps
- Sitting-5, hold chair 4, L finger thumb(FT) 2
- Standing-8 to 6, L FT 4, R FT 7
- Stand and Turn R/L-9 to 6, L FT 4
- Walking-6, feel floor 4, L FT 3
- Walk and Turn R/L-7, FT 4, Floor 5, Fixations 4, FT and Fixations 3***After a week!

Finger Thumb – Rick Collier
- Article on joint and proprioception
- Frontal cortex, Supplemental motor area
- Increased proprioception
- Increased peripheral vision
- Increased short term memory
- Increased spontaneous speech
Case Presentation – Vestibular Concussion

- Habituation Activities are the primary tools
- Consider Gaze Stabilization to improve remaining vestibular function and central preprogramming
- To foster the use of saccadic or pursuit strategies and central preprogramming
- To foster central preprogramming (imaginary target)
- Modify postural stability, base support, etc.

Case Presentation - Lenses

- Motion sensitive and/or dizziness
- Low plus lenses (+.50 to +.75), can replace sunglasses (decrease contrast?)
- Increased spatial awareness, where are the objects?
- Increased VOR gain with plus lenses, thus stabilizing blur/motion with less cortical input

*Watch out for motion from Progressive Lenses!!!

Yoked Prism – Egocentric Localization and/or Visual Midline Shift Syndrome

- Central vs. Peripheral components
- Effects of eyes closed?
- Rotational effects upon visual field – shift/slant
- Amount – varying
- Visual Localization – where are they looking?
- How does this help postural stability?
- Head posture – try wearing 10°BD and tip head
- Possible effect on cervical control – key may be the maintenance of upright and steady head position
- Bilateral cervical control may decrease symptoms?

Binasal Occlusion-Motion Sensitivity

Effect of binasal occlusion (BNO) on the visual-evoked potential (VEP) in mild traumatic brain injury (mTBI).
Ciuffreda KJ, Yadav NK and Ludlam DP

*It is speculated that mTBI attempt to suppress visual information to reduce their abnormal motion sensitivity. BNO negate the suppressive effect, thus an increase in VEP and decrease in symptoms
How to Trial a Binasal

Motion Sensitivity-Binasal and Blinking

- Most motion sensitivity is across the horizon (width)
- Binasal if too wide is bothersome, thinner better
- Blinking also helps, but binasal with blink is best!
- Sit and walk is often ok for some, but driving may be worse - speed, type of movement-horz, optic flow
- Television-Large TV worse, but farther away helps, but what about other things in visual field - z axis?
- In bed, TV is smaller-closer, no movement between
- Difficulty of movement of kids and animals

Binasal Occlusion Work?

Basic Visual Skills Therapy – VOR gain?

- Vision and balance: the optometrist’s role in managing patients with dizziness and vestibular dysfunction.
  *Overview and 2 case reports

  *Case report of patient who had been helped with vestibular therapy, but had residual dizziness. Vision therapy decreased symptoms, and improved balance.

Pseudo-Vestibular Syndrome

- Six adult cases with a pseudo-vestibular syndrome related to vergence.
  Yang Q, Jurion F and Bucci MP
  Neuro-Ophthalmology 2008;32:93-104

  *Eye movement testing can be helpful in differential diagnosis of pseudo-vestibular syndrome.
  Oculomotor training is suggested for such subjects with vertigo/dizziness symptoms to improve their abnormal eye movements and reduce symptoms.

Treatment Pearls to Consider

- Functional Mobility- Ankle and Hip Strategies
- Motor
  - Increase signal, Stand on one foot, Foam, Reaching and add head tracking
- Visual
  - Tracking, Close eyes, Peripheral Lock, Fixation
- Vestibular
  - Rotations, linear, recovery and cumulative effects
- Combinations-catching ball
- Reaction time
### Summary Overview

- Evaluation and Guidance with Substitution, Blinking, Fixation while turning, etc.
- Habituation Therapy (Gaze Stabilization)
  - Optometric Considerations
- Lenses, Prism Applications
- Selective Occlusion
- Basic Visual Skill Therapy
- Combinations...

### Thank You for the Opportunity to Share With You

### References

- Balogh-Dizziness, Hearing Loss and Tinnitus
- Herdman-Vestibular Rehabilitation
- Leigh and Zee-Neurology of Eye Movements
- Suter-Vision Rehabilitation
- Wong-Eye Movement Disorders

### For more information:

- Vision Rehabilitation Section of AOA  
  [www.aoa.org](http://www.aoa.org)
- College of Optometrists in Vision Development  
  [www.covd.org](http://www.covd.org)
- Neuro-Optometric Rehabilitation Association  
  [www.nora.cc](http://www.nora.cc)
*Guidebooks, Beginning and Advanced courses*
### Disequilibrium Evaluation Form

<table>
<thead>
<tr>
<th>Provocative Testing</th>
<th>Baseline</th>
<th>Proprioceptive/Tactile/Kinesthetic Input</th>
<th>Visual Input</th>
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<td>Lower Extremity</td>
<td>Upper Extremity</td>
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<td>Sitting</td>
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<tr>
<td>Head Tracking (Vestibular)</td>
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<td>Left to Right</td>
<td>Right to Left</td>
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<td>Automatic: Y/N</td>
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<tr>
<td>Ocular-Motor Tracking (Motion)</td>
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<td>Left to Right</td>
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<td>Stand &amp; Turn Right</td>
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