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

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
  - Central/Peripheral and Reciprocal Interweaving
  - So what’s so special or different?
- 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
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. Others

Vestibular vs. Motion Sensitivity

- VOR gain = head vs. eye movement, should = 1.0
  - Includes Subcortical and Cortical components
    - Blinking during movement eliminates motion
    - Peripheral vision provides lock for fusion and stability (vs. tunnel vision with motion peripheral)
  - 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 (PT prescribe gaze stabilization)
- *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

Tests of Dizziness, Gait and Balance

- Dizziness Handicap Inventory (DHI)
- Romberg and Sharpened Romberg test
- Hallpike-Dix Maneuver (bppv)
- 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 and Confusion (motion?)
- Inability to compensate for low hyperopia and/or decrease in VOR gain
- Changes in medications
- Orthostatic hypotension-BP drops suddenly
- Others...

Optometric Assessment

- Case History
- Observations — critical!
- Clinical Testing
  - Routine visual examination
  - Ocular motor examination
  - Disequilibrium Evaluation Form
    - This can lead guidance in “substitution”
  - Special Testing — dynamic visual acuity

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)

Special Testing

- *Dynamic Visual Acuity (DVA)
  - 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

Dizziness/Vertigo Management-Traditional

- Vestibular Rehabilitation
  - Repositioning-for BPPV (Vertigo)-reset the crystals
  - Dix-Hallpike, Epley, Brandt-Daroff Maneuver
  - Epley Exercises as well
  - *Substitution
  - *Habituation
  - *Eye Exercises
- Medical Treatment
  - Medication
  - Surgery

Benign Paroxysmal Positional Vertigo

BIG Picture in Treatment

- Address BPPV Positioning if true vertigo
- Habituation Therapy (vestibular component)
- Eye Movement/Vergence 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 Physical Therapy

“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 does the patient cope or recover from the increased symptoms?
2-Assumes a “No Pain, No Gain” attitude

Optometric Management

- Visual Guidance
  - Consider substitution and habituation activities
  - *Awareness of head movement vs. visual motion
  - *Blinking, Central/Peripheral, Fixation (visual anchor)
- Lenses
  - Progressives vs. Bifocals vs. Multiple Pairs-SV
  - *Low plus a valuable tool or cut minus
  - Spectacles vs. Contact Lenses
  - Aniseikonia (Shaw Lens)
Optometric Management

- Prism
  - Stabilize binocularity
  - Low base in (1-3 total)
- Selective Occlusion
  - Binasal, Pinholes?
- Basic Binocular and Visual Skills
  - Much more than “orthoptics”
  - Importance of visual skills to help VOR gain

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?)
  - Habituation therapy likely modifies VOR gain
  - Increase VOR gain with EOM therapy - pursuits, saccades
  - Increase VOR gain with low plus lenses, or cut minus
- KEY – Must learn to control symptoms (scale 0-10) AND improve VOR gain to be successful in overall treatment

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
  - Habituation-Gaze Stabilization Therapy
  - Lens and Prism Considerations (Binoc and BI)
  - Binasal Occlusion
  - Basic Visual Skill therapy – EOM, Binocularity

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 others

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

### Effects of Hat, Side Shields
- Can Decrease Symptoms
  - Visual Motion Hypersensitivity
  - Photosensitivity - fluorescents
    *They are Proprioceptive Dependent
- But...Can Also Increase Symptoms
  - Vestibular Concern
    *They are Visually Dependent

### 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
- Stand and Turn R/L-9 to 6
- Walking-6, feel floor 4
- Walk and Turn R/L-7, Feel Floor 5, Fixations 4, Fixations 3***After a week!

### Case Presentation – Vestibular Concussion
- Substitution, Bean Bag and Habitation Activities are CRITICAL
- 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.

### Gaze Stabilization
- Size/Complexity of target
- 10X each, Right/Left and Up/Down rotations
- Range – narrow to wider
- Speed – slow to faster
- *Monitor symptoms
- Add other elements as needed:
  - Central/Peripheral, Depth (X,Y and Z)
  - Proprioception
  - Near vs. Far targets

### Peri and Extrapersonal Space

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**FOCAL EXTRAPERSONAL**

**PERIPERSONAL**

**AMBIENT EXTRAPERSONAL**
Case Presentation - Lenses

- Motion sensitive and/or dizziness
- Low plus lenses (+.50 to +.75), decrease minus
- 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!!!

How Might Binasal Occlusion Work?

- 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
- Difficulty of movement in the environment!
- 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

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 negates the suppressive effect, thus an increase in VEP and decrease in symptoms

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
- Difficulty of movement in the environment!
- 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
### 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.

### Summary Overview

- Evaluation and Guidance of dizziness 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
# Disequilibrium Evaluation Form

<table>
<thead>
<tr>
<th>Provocative Testing</th>
<th>Baseline</th>
<th>Proprioceptive/Tactile/Kinesthetic Input</th>
<th>Visual Input</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower Extremity</td>
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<tr>
<td></td>
<td></td>
<td>Upper Extremity</td>
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<tr>
<td></td>
<td></td>
<td>Neck</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Central/Peripheral Awareness</td>
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<td></td>
<td></td>
<td>Dynamic Fixation</td>
<td></td>
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</tbody>
</table>

### Sitting

<table>
<thead>
<tr>
<th>Head Tracking (Vestibular)</th>
<th>Left to Right</th>
<th>Right to Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic: Y/N</td>
<td></td>
<td></td>
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</tbody>
</table>

### Ocular-Motor Tracking (Motion)

<table>
<thead>
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<th>Left to Right</th>
<th>Right to Left</th>
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<tbody>
<tr>
<td>Automatic: Y/N</td>
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</tbody>
</table>

### Standing

<table>
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<tr>
<th>Anchor: Y/N</th>
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### Stand & Turn

<table>
<thead>
<tr>
<th>Stand &amp; Turn Right</th>
<th>Step: 1 / 2 Anchor: Y/N</th>
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<tbody>
<tr>
<td>Stand &amp; Turn Left</td>
<td>Step: 1 / 2 Anchor: Y/N</td>
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### Walking

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<th>Anchor: Y/N</th>
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<table>
<thead>
<tr>
<th>Walk &amp; Turn Right</th>
<th>Anchor: Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk &amp; Turn Left</td>
<td>Anchor: Y/N</td>
</tr>
</tbody>
</table>
VESTIBULAR COURSE REFERENCES

   Nice look at development and vestibular processing.

Berthoz, Alain The Brain’s Sense of Movement. Harvard University Press 2000
   Advanced look at proprioception, vision and vestibular processing.

Herdman, Susan Vestibular Rehabilitation (cd-rom). Contemporary. FA Davis and Co 2007
   The comprehensive review of vestibular rehabilitation.

Leigh RJ and Zee DS The Neurology of Eye Movements (dvd). Oxford University Press 2006
   The comprehensive review of eye movements.

McCredie, Scott Balance-In Search of the Lost Sense. Little Brown and Company 2007
   Overall clinical view at variety of balance disorders, including adhd, dyslexia.

Ottenbacher KJ, Short MA Vestibular Processing Dysfunction in Children. Routledge 1985
   Compendium of research on vestibular processing in children.

   Simplified view, diagrams and cd of eye movement disorders.