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Session 106: What If It's Not BPPV? Vestibular Functional Assessments Translated to Treatment
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Objectives

■ Name vestibular functional assessments to be used to assess motion sensitivity, balance and dynamic visual acuity.
■ Translate findings of vestibular assessments into a treatment plan for patients with vestibular rehabilitation.
■ Develop a treatment plan to include the four components of a vestibular rehabilitation program as directed by the clinical practice guidelines and recognized by assessments.
■ Assess a case study to determine vestibular functional limitations, treatment program and progression options for optimal outcome of a vestibular rehabilitation program.
Vestibular System

- Located in inner ear, composed of static and dynamic sensory inputs to provide position sense in space
- Provides input about both linear and angular head velocity
- Central vestibular system located in pons and medulla coordinate input from vision, vestibular and somatosensory systems
- Motor output:
  - Vestibulo-ocular reflex for gaze stabilization
  - Vestibulo-spinal reflex for postural stability through musculoskeletal system

(Herdman, 2007) (Kyllonen et al, 2016)

Vestibular Rehabilitation

- The purpose of vestibular rehabilitation is to promote compensation for vestibular deficits through an individualized exercise-based program.
- Customized, patient-specific program consisting of movement-specific exercises that lead to adaptation and compensation of the CNS for peripheral vestibular dysfunction.
- Suppression of vertigo and desensitization occurs through persistent exposure to provoking movements. This allows the CNS to “learn” how to compensate for abnormal vestibular input through neuroplasticity.
- Through movement-based activities, we can help the patient to function daily with decreased dizziness or total resolution of symptoms, and improve balance to decrease risk of falls.
- Recovery of dynamic deficits is not dependent on recovery of static deficits
- Begin during the early phase of plasticity, which is in the first month post-onset

(Seyd, 2016) (Lacour & Vidal, 2016) (Lacour & Bernard Demarce, 2015)

What if it’s not BPPV?

- Although BPPV is the most common cause of dizziness, however other diagnoses may include:
  - Peripheral vestibular hypofunction (labyrinthitis, neuronitis, Meniere’s disease)
  - Central (multiple sclerosis, CVA, post-concussion syndrome)
  - Cervicogenic dizziness
Peripheral Vestibular Hypofunction

- Most common report of symptoms include dizziness, described as spinning, with imbalance
  - Sudden onset of dizziness (constant spinning) persisting for several days
  - Motion sensitivity
  - Imbalance
  - Gait dysfunction with wide base of support, seeing, balance challenge with turns or with head movements
  - Possible falls
  - Possible neck pain and cervicogenic headaches
- Prognosis: excellent with vestibular rehabilitation

(Haley, 2014) (Wildermuth and Krumel, 2014)

Central Presentation

- Most common presentation is balance deficits with postural instability
  - Ataxic gait
  - Coordination deficits – finger to nose, shin slide, dysdiadochokinesia
  - Oculomotor deficits – smooth pursuit, saccades, convergence
  - May present with nystagmus – vertical or torsional
  - Cerebellar lesion (CVA, MS, tumor) – constant dizziness
- Prognosis: patients will improve, however will plateau and can expect long-term balance deficits and dizziness

(Herdman, 2007)

Cervicogenic Dizziness

- Theory: abnormal cervical afferent input that conflicts with visual and vestibular cues causing dizziness
- Most common presentation: dizziness described as lightheadedness, postural instability, symptoms provoked by head/neck movement, sustained cervical spine positioning
  - Gradual onset weeks-months following whiplash or closed head injury
  - Associated with postural syndrome / postural strain of cervical spine
  - Neck pain, cervicogenic headaches
  - Imbalance with head movement
  - Ataxic gait
- Prognosis is good with vestibular rehabilitation, manual therapy and therapeutic exercise to address cervical spine deficits

(Nilsson et al, 2000)
Presentation: Chronic Motion Sensitivity

- Chronic motion sensitivity affects 20-30% of general population described as sub-clinical chronic motion sensitivity
- Motion sensitivity: visual-vestibular conflict, long-term results in activity avoidance
  - Difficulty riding roller coasters, boats, reading in the car, postural instability with moving visual surroundings
- These patients will benefit from vestibular rehab for improved sensory integration, re-weighting of sensory inputs to decrease motion sensitivity

(Alyahya et al. 2016)

Treatment: Vestibular Rehabilitation

- Vestibular rehabilitation program should include:
  - Gaze stabilization
  - Habituation
  - Balance and Gait
  - Endurance
- Assess above areas to determine deficits, treat according to findings
- Sensory integration requires corresponding information from vision, vestibular and somatosensory systems
- Assessments must address each system function and utilization and sensory integration


Functional Assessment: Gaze Stabilization

- Best assessed by Dynamic Visual Acuity using eye chart, horizontal and vertical
- Patient is seated specified distance from eye chart (Snellen = 20ft)
- Static visual acuity: patient to read lowest line without errors
- Dynamic visual acuity: therapist rotates head 30 deg each direction at 2Hz (2 turns/sec or 120rpm on metronome) while patient reads lowest line without errors
  - >2 line change between static and dynamic visual acuity indicates deficit in DVA and will lead to gaze stabilization exercises
  - Gaze stabilization will also be utilized for sensory integration by adjusting visual and somatosensory cues, so should be assessed and performed regardless of DVA findings
Treatment: Gaze Stabilization

- Goal: promote vestibular adaptation
  - Vestibular adaptation - long-term changes in neuronal response to head movements to reduce symptoms, normalize VOR and postural stability
- Requires head movement for vestibular input to VOR
- Retinal slip: process of losing visual focus on the target during head movement
  - Target blurs with head movement if VOR is not functioning properly
- Performed in both horizontal and vertical planes
  - Prescribed 3x/day: Acute/subacute total 12 min, chronic total 20 min/day
  (Hall et al, 2016)

Gaze Stabilization: Treatment Progression

- Increase speed of movement: goal of 2 Hz or 120bpm on metronome
- Add busy visual background to minimize visual dependence
- Adjust base of support to challenge balance
- Adjust surface to more compliant surfaces for improved sensory integration in balance

- Gaze Stabilization:
  - Video 1
  - Video 2
  - Video 3

Functional Assessment: Habituation

- Best assessed with Motion Sensitivity Quotient
  - High inter-rater reliability, good validity, sensitivity and specificity for detecting motion-provoked dizziness – excellent functional outcome measure for objective findings of reported symptoms
  - Findings from MSQ will direct treatment
  - Patient moves into 16 different positions, rates dizziness 0-5 with each movement, therapist times and scores duration of symptoms
  - Score is calculated: total of score column x number of provoking positions, divide by number of positions that provoke symptoms (16 or less)
  - This test provides information about specific positions that provoke symptom and works as a roadmap to treatment through habituation
  (Akin & Davenport, 2003)
Baseline Symptoms Intensity (0‐5 Scale) Duration (5‐10s = 1, 11‐30s = 2, >30s = 3) Score (Intensity + Duration)

1. Sitting to supine
2. Supine to left side
3. Supine to right side
4. Supine to sitting
5. Left Hallpike-Dix
6. Up from left HD
7. Right Hallpike-Dix
8. Up from right HD
9. Sitting, head tipped to left knee
10. Head up from left knee
11. Sitting, head tipped to right knee
12. Head up from right knee
13. Sitting head turns (5x)
14. Sitting head pitches (5x)
15. In stance, 180 degree turn to left
16. In stance, 180 degree turn to right

(Total Score x total # positions producing symptoms) ÷ 20.48

0-1 0 = Mild
11-30 = Moderate
>30 = Severe

Treatment:
Habituation

- Goal: reduce behavioral response to repeated exposure to a provocative stimulus
- Habituation requires provocation of symptoms through vestibular stimulation
  - Significant and ongoing patient education for compliance
- Repetition of movements or activities that cause mild-moderate symptoms promotes synaptic level neuroplasticity
- Recent approaches involve optokinetic stimuli or virtual reality

Habituation:
Treatment Progression

- Increase speed of movement
- Decrease base of support
- Perform in front of busy background
- Add body movement
- Vary surface
- Utilize findings from Motion Sensitivity Quotient, progressing to higher ratings as initial exercises become less symptomatic
- Consider home and work environment
- Consider functional and recreational activities
Functional Assessments: Balance, Gait and Endurance

- Vestibular EDGE documents from Academy of Neurologic Physical Therapy – recommended outcome measures: http://www.neuropt.org/docs/default-source/vestibular-edge/v-edge-clinical-recommended-by-domain.pdf?

- Balance and Gait:
  - Modified Clinical Test of Sensory Integration in Balance (mCTSIB), Dynamic Gait Index, Functional Gait Assessment, Tinetti, Berg, BEST, MiniBEST, BESS, Neurocom Sensory Organization Test (SOT)
  - 10 meter walk test, TUG (manual and dual task), Functional reach

- Endurance
  - 6 minute walk test, 5 time sit to stand, 30s chair stand

Vestibular EDGE: Shared with permission from The Academy of Neurologic Physical Therapy. VEDGE Taskforce Members: Matthew R. Scherer, PT, PhD, NCS, Chair; Linda B. Horn, PT, DScPT, MHS, NCS, Co-Chair; Elizabeth Dannenbaum, MScPT; Jennifer L. Fay, PT; Karen H. Lambert, PT, MPT, NCS; Teresa A. Rice, PT, MPH, NCS; Jennifer L. Stoskus, PT; Diane M. Wrisley, PhD, PT, NCS

Treatment: Balance and Gait Training

- Goal: improve static and dynamic balance to decrease risk of falls and injury, promote return to activity

- Static balance
  - Vary surface
  - Vary base of support
  - Add dynamic movements of head, arms, perturbations

- Dynamic balance
  - Walking with head turns
  - Vary base of support – marching, tandem walking, sideways stepping
  - Vary visual input – busy background, holding mirror, special glasses with stripes, sunglasses

Treatment: Endurance

- Goal: improve endurance to address sedentary lifestyle that occurs secondary to dizziness and imbalance

- Address through walking or aerobic exercise.

- General conditioning exercise such as stationary bicycle alone has not been found to be beneficial for patients with vestibular hypofunction

(Hall et al. 2016)
Treatment: Oculomotor Function

- Smooth Pursuit: tracking target moving at various speeds and directions
- Saccades: looking back and forth between targets
  - Begin with head still
  - Add VOR component by having targets placed to require head turning left/right, up/down, diagonal, etc.
  - Move eyes to target, then turn head while maintaining focus on the target
- Convergence: tracking target from a distance in toward nose
  - Stop at point the target becomes double, back up slightly and maintain visual focus
  - Move target from various angles
- Near/far convergence for transition to classroom setting
- Optokinetic exercises for tracking in busy environment, requiring stability and decreased sensory integration (YouTube)

Transitioning Treatment Into Function

- Gaze stabilization: functional
  - Static gaze stabilization and gaze stabilization with head turns (saccades) will help to improve:
    - Walking while scanning environment: looking at flowers, leaves
- Habituation: functional
  - Repeated movement of bending
  - Loading dishwasher or washing/drying dishes
  - Folding or hanging laundry
  - Placing items on the floor
  - Filing bills or other paperwork
- Sensory integration challenging multiple systems
  - Gaze stab on foam with busy visual background
  - Standing balance on compliant surface with head movement or eyes closed
    - Getting up to use the bathroom at night with only a nightlight

Breaking Down Functional Activities

- Consider the various components of an activity, break it down into components
  - Sweeping: begin sitting performing head movement only while tracking object
    - Transition to standing with some trunk movement to pull in balance component
    - Step while performing sweeping movement with stepping for return to function
  - Working in kitchen: begin with head and/or body turns 90 deg, 180 deg to simulate moving back and forth to target – sitting or standing
    - Progress to ad turn plus reach at waist level
    - Add bending to reach for pots/pans or reaching overhead into cupboards
    - Repeat various series of movements to simulate cooking
Factory work on line:
- What is the repeated movement? Left to right on conveyor belt picking up moving object, performing task and placing on the opposite side
- Posture? Standing or sitting?
- What is the surface?
- What is the visual background? Auditory background?

Student post-concussion returning to school:
- Sensory inputs: walking through crowded hallway, head turns to look from students to teacher while participating in discussion
- Sitting in class (cervical spine posture if neck pain/headaches), distance from teacher/board
- Oculomotor function and transitioning from worksheet or book to teacher/board
- Attending to auditory stimuli during times with multiple other stimuli (visual, posture)

Office work on a computer:
- Data entry from paper to computer
- Scrolling on computer screen – tracking moving target - youtube
- Filing papers
- Answering phone, looking by from door as people pass or walk into office
- Posture – sitting? Standing? Options to change position for musculoskeletal discomfort

Participation and Function
- Patient questionnaires
  - Dizziness Handicap Inventory
  - Activities-Specific Balance Confidence Scale
  - Vertigo Handicap Questionnaire (VHQ)
  - Vestibular Disorders Activities of Daily Living Scale (VADL)
  - Vestibular Rehabilitation Benefit Questionnaire (VRBQ)
  - UCLA Dizziness Questionnaire (UCLADQ)
  - Vestibular Activities and Participation (VAP)
  - Disability Rating Scale (DRS)
Case Study 1

- 45 y/o female patient presents with chief c/o dizziness that was a constant spinning sensation for 3 days and has been slowly improving. Onset was 10 days ago. She currently reports imbalance with turns, feels that she veers to the right while walking, and does not tolerate much head movement without dizziness and nausea. She works as a cashier at the grocery store and occasionally has to help stock shelves. She is unable to work at this time due to dizziness and imbalance.
- Diagnosis: Left vestibular hypofunction secondary to vestibular neuronitis
- Activities-Specific Balance Confidence Scale: 67% (moderate)
- Dizziness Handicap Inventory: 82 (severe)
- Motion Sensitivity Quotient: 73.4 (severe motion sensitivity)
- Dynamic Gait Index: 17/24 (increased risk of falls <21/24)
- Dynamic Visual Acuity: 4 line change (>2 line change is deficit)
- Patient goals: return to work, walk normally, eliminate dizziness

Treatment Techniques:

Treatment Progression:

Prognosis: ______________________________

Long-term limitations: ____________________

Return to work: _________________________

Case Study 2

- 48 y/o female presents with dizziness, decline in balance and gait with 5 year history of multiple sclerosis. Current symptoms include dizziness, difficulty reading, difficulty performing work tasks on computer, and increased frequency of falls. She experiences double vision and has to close one eye while reading. Patient prefers not to use assistive device. Diagnosis: MS exacerbation
- Saccades and Smooth pursuit: abnormal
- Patient Questionnaires:
  - Activities-Specific Balance Confidence Scale: 67% confidence in balance
  - Dizziness Handicap Inventory: 82
- Motion Sensitivity Quotient: 73.4
- Dynamic Gait Index: 17/24
- Dynamic Visual Acuity: 3 line change
- Patient goals: decrease risk of falls without assistive device, continue working, read for 45 minutes - 1 hour
Case Study 3

- 28 y/o female presents with c/o dizziness and imbalance. She has history of whiplash injury 6 months ago secondary to MVA. She reports lightheadedness that occurs mid-day and imbalance while walking and turning her head. She works as a nurse in a busy outpatient clinic where she fears the patients will think she is intoxicated due to her unsteady gait. She walks with 1 finger on the wall while bringing patients back to the room because she feels more steady. She is also experiencing some stiffness in the neck and occasional headaches. Diagnosis: cervicogenic dizziness

- Patient Questionnaires:
  - Dizziness Handicap Inventory: 56 (moderate)
  - Activities-Specific Balance Confidence Scale: 54% (moderate)

- Motion Sensitivity Quotient: 26.4 (moderate)
- Dynamic Visual Acuity: 1 line change (WNL)
- mCTSIB: increased sway all conditions, able to maintain 30s
- Dynamic Gait Index:
  - Gait: ambulates with wide base of support, weaves, increased instability with head turns
  - Repeated walking with cervical isometrics: steady gait with straight path

- Patient Goals: decrease headaches and neck pain, improve balance, perform work duties without difficulty

- Treatment Techniques:

- Treatment Progression:

- Prognosis: ______________________________
- Long-term limitations: ____________________
- Return to work: __________________________
Questions?

- Lab. gaze stabilization
- VEDGE Documents
- Balance Assessments

References