PHTH 7210 – Contemporary Techniques in Physical Therapy

Vestibular Rehabilitation Component

**Background and Objectives:**
The basis for the class is going to be clinical decision making in the context of complaints of dizziness and imbalance. This course operates on the assumption that vestibular deficits are the source of many problems with balance and falls regardless of the population being treated.

Our goal for the weekend is not to make you specialist providers of vestibular rehabilitation, but rather to provide you with tools that should improve your ability to examine and treat with potential vestibular abnormalities in your practice area. To accomplish this goal, we will utilize a decision-making algorithm that is derived from the Vestibular Rehabilitation Textbook written by Susan Herdman with input from Janene Holmberg, PT, NCS. You will find this clinical decision making algorithm on a subsequent page of the syllabus.


**Tasks before class:**
Before the weekend we would like you to review the decision making algorithm, the attached power point presentations and skim through the text. (Chapters listed below). We expect that a smaller portion of the course will be lecture and more will be laboratory based.

**Relevant Readings:**
Chapter 1: Anatomy and Physiology of the Normal Vestibular System
Chapter 3: Role of the Vestibular System in Postural Control
Chapter 17: Physical Therapy Management of BPV
Chapter 19: Physical Therapy Assessment of Vestibular Hypofunction
Chapter 20: Interventions for the patient with Vestibular Hypofunction

There are several other chapters that are useful for those working in specialty areas of practice but will not be covered specifically:

Neurologic Rehabilitation Practice:
Chapters 26

Orthopedic Practice:
Chapter 29

Geriatric Practice:
Chapter 23
Pediatric Practice:
Chapter 22

**Completion of this portion of the course (and passing) will be determined by two things:**

1) Competency testing of examination and treatment techniques during the weekend. (see the attached competency check off)

2) Submission of a clinical case report before the end of the semester (see syllabus for the description)

**Schedule:**

We are scheduled for class from 4-8 on Friday March 7\(^{th}\), and  8 am - 5 pm on Saturday, March 8th. Our tentative schedule will be the following:

- 4-6 pm Friday  Lecture: Vestibular Anatomy and Physiology / Bedside Vestibular Examination
- 6:30-8 pm Friday:  Lab: Bedside vestibular examination
- 8-10 am Sat.  Lecture: Pathology – BPPV and Unilateral Vestibular Loss
- 10:30-12:00 Sat.  BPPV treatment laboratory
- 1:00 –?? Sat.  Competency Practice and Testing
Glossary of Vestibular Terms

Ampulla= Swelling on one end of the semi-circular canal. Houses the sensory structure responsible for transducing angular acceleration.

Common Crus= Connection of the anterior and posterior semicircular canals that empties into the utricle.

Cupula / Christae = sensory structure that lies within the ampulla of the semicircular canal. Involved in sensing angular acceleration.

Endolymphatic sac= Structure that absorbs endolymph. In Meniere’s disease, endolymph is not absorbed well and one surgical treatment is to permanently insert a tube into the sac to facilitate drainage (endolymphatic shunt).

Ewald’s second law= Depolarization (excitation) of the cupula within the inner ear does not saturate whereas hyperpolarization (inhibition) does saturate.

Fukuda stepping test= Patient marches in place with eyes closed for 50 steps. Rotation of more than 30 degrees or translation of more than 3 feet is considered abnormal (possible vestibulo-spinal abnormality).

Gain= Slow phase eye velocity/head velocity. Normal value is 1.0. Low gain <1.0, high gain >1.0.

Habituation= Response decline that persists over time induced by a repeated stimulus.

Head shaking nystagmus test= clinical test in which a patient’s head is oscillated horizontally twenty times in 2Hz. If this elicits significant horizontal nystagmus (>3 quick phases), or if it clearly increases spontaneous nystagmus, it is considered positive. Its presence suggests vestibular asymmetry (different gain) between the two horizontal SCC.

Head thrust test= clinical test in which patient is told to fixate a stationary target while their head is moved short amplitude but very quickly horizontally. If this elicits a corrective saccade at the end of the head movement, it is considered positive. Its presence suggests a decrease in VOR gain.

Labyrinth= inner ear divided into membranous and bony parts

Linear acceleration= Change in velocity along a straight path (vertical or horizontal) sensed by the otoliths of the inner ear.

Maculae= Sensory structure including hair cells that senses linear movement within utricle and saccule. Otoconia sits on top of the maculae.

Mal de debarquement= Perception of rocking as if on a boat (sea legs) that persists after debarking from prolonged passive transportation (sea cruise, train, plane).

Membranous labyrinth= Structure suspended within bony labyrinth by fluid and supportive connective tissue. Membranous labyrinth contains the membranous portion of the 3 semicircular canals, the utricle and saccule. It is filled with endolymph.

Meniere's disease= Problem in absorption of endolymph into the endolymphatic sac of unknown etiology.

Nystagmus= A non-voluntary rhythmic oscillation of the eyes. It is characterized by fast and slow components beating in the opposite directions. The convention is to name the direction by the fast phase. It can be a normal response to stimuli such
as head rotation or visual stimulation or pathologic in response to altered vestibular function.

Oscillopsia= false illusion of movement of environment. Subtypes include head-induced in patients with severe vestibular hypofunction when they move their head, and spontaneous in patients with spontaneous, acquired nystagmus.

Otoconia= Structure in the inner ear. Calcium carbonate crystals in utricle and saccule.

Otoliths= Structures with in the inner ear that sense linear acceleration (utricle and saccule).

Perilymph= type of fluid in inner ear(high sodium, low potassium similar to extracellular fluid in rest of body).

Saccadic eye movement= eye movement used to quickly move eye.

Saccule= otolith structure in the inner ear that detects vertical translation motion of head.

Semicircular canals (anterior or superior: posterior or inferior, horizontal or lateral)= structure in inner ear. Fluid loops responsible for measuring angular acceleration.

Smooth pursuit eye movement= eye movement used to track small moving targets.

Utricle= otolith structure in inner ear that detects horizontal translation and tilt of head.

Velocity storage= neural circuit in dorsal medulla that stores head velocity neural signal for up to 90 seconds.

Vertigo= sensation of motion of self or environment (rotation, translation, or tilt.)

Vestibular ocular reflex= movement of eyes opposite to movement of head. Useful during head movements to stabilize gaze.

VOR cancellation= movement of eyes that suppresses VOR. Useful when trying to follow target that is moving synchronously with head.
**History:**
PMH / PSH / Fall & Near fall history

Objectives:
1) Characterize chief complaint (Imbalance, dizziness/vertigo, lightheadedness)
2) Determine Opportunity (frequency of exposure)
3) Gain insight into Judgement (Attention, Cognition, Insight, Safety awareness)
4) Develop a plan to assess Ability (physiologic, sensory, motor)

**Physiologic Examination:**
- HR, BP, O2 Sats
- Orthostatics
- Blood sugar, Incontinence?
- Global neuro (seizures, dementia)

**Sensory Examination:**
- Somatosensory: proprio, vibration
- Visual: acuity, extraocular mvmts, visual fields
- Vestibular: VOR, VSR tests, BPPV
- Spatial orientation

**Neuro-musculo-skeletal examination**
- MMT (sagital & frontal)
- ROM, Tone, DTR's
- Fatigue, Motor control (synergies, coordination)
- Biomechanical environment

**Sensory Integration / Sensory Re-weighting Examination**

**Functional Examination**
- Tasks to examine: Stable COM/BOS, Dynamic COM/Stable BOS, Dynamic COM & BOS
- Tests to consider: CTSIB, DGI/FGA, Berg, FR, TUG, Tinetti
- Examine ability to tolerate external environmental constraints
  (outside, uneven terrain, varied illumination, visual flow, moving surfaces)
Anatomy and Physiology of the Vestibular System

Vestibular dysfunction

- “Balance disorder” is among the two most common diagnoses among short-stay hospital admissions in persons over the age of 65.
- Falls are the leading cause of fatal and nonfatal injuries in persons > 65 in the US.
- Of all falls suffered by the elderly, approximately 50% can be attributed in some degree to vestibular dysfunction.

Vestibular Anatomy

- The organs of balance are located in each inner ear or labyrinth
- There are two components to the labyrinth:
  - The outer boney shell: boney labyrinth
  - The inner contents: membranous labyrinth
Boney and membranous labyrinths

- Located in the petrous portion of the temporal bone
- Contains the auditory and vestibular sensory organs
- Cavities are filled with perilymph (similar in composition to CSF)

- Composed of thin membranes made up of simple epithelium
- Canals and chambers are filled with endolymph

- Contains five structures responsible for transducing information regarding head movement and head position in space
  - 3 SCC’s (anterior, posterior, horizontal)
  - 2 otolithic organs (utricle and saccule)
SCC’s

• Primarily responsible for sensing angular acceleration (rotational motion)
• Aligned at right angles to each other, with the horizontal canals sloping 30 degrees down and back
• Both ends of the canal terminate in the utricle; one end in a widened area termed the ampulla
• The anterior canal and the posterior canal fuse on the end away from their ampulla, this common entry into the utricle is called the common crus
**Saccule and Utricle**

- Primarily sense linear acceleration and head tilt
- The utricle lies in approximately the horizontal plane and the saccule in the vertical plane
- Both ends of the canal terminate in the utricle; one end in a widened area termed the ampulla
- Both contain an area of specialized epithelium called the macula

**Otolithic Organ**

**Otoconia / Otoliths**
Orientation of the otolithic organs

Orientation of the SCC’s

Vestibular physiology

• Hair cells
  – Stereocilia and Kinocilia
• Kinocilia
  – Deflect towards – increase nerve activity
  – Deflect away – decrease nerve activity
• Functional Groups found in each ampulla and otolith organ
Co-planar pairing

- The SCCs are linked in functional pairs
  - Right and left horizontal
  - Right anterior & left posterior
  - Right posterior & left anterior

Paired canals response to the same stimulus

- In the SCC’s the hair cells are oriented so that the hair cells on one side are bent towards the kinocilia while the hair cells in the paired canal on the opposite side are bent away from the kinocilium.
- As a result of this arrangement, a single head movement will have opposing effects on the bilaterally functioning system.
Review of Semicircular Canal Function

Otolithic Organs

- Saccule
- Utricle
Sensory Redundancy

- When disease affects the input from one member of the co-planar pair (as in vestibular neuritis) the CNS will still receive information about head velocity within that plane from the contralateral member of the pair.
  - Without head motion, the CNS gets unbalanced input.
  - With head rotation in the direction of the impaired side, the vestibular nerve centers will receive a decreased nerve conduction signal from the intact side, which can be interpreted by the CNS as rotation.
Conduction of Vestibular Signals

Vestibular nerves (in IAM)

Vestibular Nuclei
- Pons/Medulla
- Four major nuclei
  - Superior – VOR
  - Medial – VOR, vestibulospinal
  - Lateral – vestibulospinal
  - Descending – cerebellum
- Connections to reticular activating system
Vestibular Nuclei & Target Structures

Vestibulo-Ocular Reflex

• Goal: To maintain stable vision during head motion

Vestibulo-ocular reflexes

• Vestibular nuclei:
  – Superior
  – Medial
• Effector Targets:
  – Cranial Nerves
    • (III, IV, VI)
• Central Processor:
  – Cerebellum
    • Flocculonodular lobe
    • Vermis

ANGULAR STIMULATION

Gaze Position

Head Position

Head Rotation

Time
Vestibulospinal reflexes

Vestibular Spinal System

- Medial Vestibulospinal tract
  - Cervical control and eyes
- Lateral Vestibulospinal tract
  - Postural control (cone of LOS tips to lesioned side)
- Functions
  - Projects primarily to cervical (MVST), also thoracic/lumbar (LVST)
  - Most problems in neck/trunk
  - Vestibular alone cannot determine COM motion, somatosensory info from neck/trunk critical
  - Scales limb/trunk adjustments to head motion
  - Antigravity muscle tone and postural alignment

Other related structures

- Reticular activating system
- Cerebellum
- Eye movement control systems
- Vascular Anatomy
RAS

• Mediates connections to autonomic responses

• Reticulospinal tracts reinforce motor effects of VST

Cerebellum

• The cerebellum plays a key role in the plasticity of the vestibular system (ie the ability to adapt to peripheral lesions)

• If the cerebellum is affected, adaptability is compromised.

Cerebellum

• Flocculus – gain of VOR
  – Arnold Chiari malformations

• Nodulus – duration of VOR, otolith
  – Medulloblastoma (positional nystagmus)

• Vermis-truncal stability
  – ETOH, thiamine deficiency
Eye movements relevant to vestibular system function

- Nystagmus
- Saccades
- Smooth Pursuits

Nystagmus resulting from the peripheral vestibular system is a “hard-wired” phenomenon

In the context of pathology, accurate interpretation leads to accurate diagnosis and treatment

Nystagmus

- Reflexive eye movement
- Cardinal objective sign of vestibular dysfunction
- Jerk nystagmus
  - slow phase: vestibular driven
  - fast phase: central “reset”
  - gaze in direction of fast phase intensifies nystagmus (Alexander’s law)
- Always labeled by the fast phase
- Nystagmus in the direction of stimulated SCC (Ewald’s law)
### Vertebrobasilar Artery

- Posterior inferior cerebellar (PICA)
  - Cerebellum, dorsolateral medulla

- Basilar artery – pons

- AICA
  - Labyrinthine artery
    - Anterior – horizontal/superior SCC
    - Posterior – br. of vestibulocochlear
  - Ventrolateral cerebellum, pons

- SCA
  - Superior cerebellum
Differential Diagnosis of Dizziness/Imbalance

Dizziness

Dizziness
Vertigo
Lightheadedness etc.

Imbalance

(J.M. Holmberg, PT, NCS)
Differential Impairment
Categories of Imbalance

- History of Falling Impairments in 2/3 sensory systems
  Fall Risk Identified
  (Berg or Tinetti Standardized Tests)

- Multifactorial Balance Loss

- Complaints of Oscillopsia
  +++Clinical VOR Abnormalities
  +++Profound falls Vestibular conditions
  ++Gait abnormalities

- Lower Extremity Numbness
  And/or
  Weakness

- Central Neurologic Dysfunction

- Abnormal Neurologic Signs & Symptoms

- Bilateral Vestibular Loss

- Peripheral Neuropathy
Differential Impairment
Categories of Dizziness

(D. M. Holmberg, PT, NCS)
DIZZINESS as a SYMPTOM

- VERTIGO:
  - distinct, immediate, incapacitating sensation of rotary movement or being pulled from vertical
- IMBALANCE:
  - unsteadiness frequently related to walking
- LIGHTHEADEDNESS:
  - less arresting, floating, minor unsteadiness/nausea
- CONFUSION: alteration in thought
- PRE-SYNCOPE: faintness, near LOC, fading vision

Understanding the “Dizzy” History

- Far most important part of exam
- Extremely difficult for patient
- Important to note:
  - Onset
  - Quality/intensity
  - Temporal Pattern
  - Associated Symptoms
  - Contributing Factors

ONSET

- Sudden
  - spontaneous episodes
  - positionally-evoked
- Gradual worsening
- Single event or episodic
- Continuous
- Crisis or Event
- Associated Symptoms:
  - auditory (tinnitus, fullness) or autonomic
**Temporal**

- Duration between major episodes
- Distinct length of each episode

**CONTRIBUTING FACTORS**

- Motion-provoked
  - head position with respect to gravity
  - body motion, i.e. car, escalator, etc.
- Visually-induced
  - reading, busy environments
- Illness or hospitalization
  - history of viral infection, IV antibiotics
- Environment

**VASCULAR RED FLAGS**

- Dizziness with exercise
- Loss of consciousness with dizziness
- Only noted upon rising, supine to sit or sit to stand (postural hypotension)
- Initial vertigo spell was associated with severe lateropulsion (unable to stand without assist)
- Associated with Headaches
Dizziness associated with a loss of consciousness or with exercise

Medical Referral to rule-out Cardiovascular origin

Differentiating between Peripheral & Central Dizziness

<table>
<thead>
<tr>
<th></th>
<th>Peripheral</th>
<th>Central</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nausea, emesis</td>
<td>Severe</td>
<td>Moderate</td>
</tr>
<tr>
<td>Imbalance</td>
<td>Mild</td>
<td>Severe</td>
</tr>
<tr>
<td>Hearing Loss</td>
<td>Common</td>
<td>Rare</td>
</tr>
<tr>
<td>Oscillopsia</td>
<td>Mild</td>
<td>Severe</td>
</tr>
<tr>
<td>Neurologic sign</td>
<td>Rare</td>
<td>Common</td>
</tr>
<tr>
<td>Compensation</td>
<td>Rapid</td>
<td>slow</td>
</tr>
</tbody>
</table>

SENSORY ORGANIZATION

- **Low tech/Clinical Testing**
  - CTSIB (Clinical Test for Sensory Interaction in Balance)

- **High tech**
  - Computerized Dynamic Posturography
    - Reliable, Valid, Highly sensitive
    - Gold standard for all other tests
  - Static forceplate measurements
BEDSIDE VESTIBULAR EXAMINATION

VESTIBULAR Gait

- Wide BOS
- Maneuvering “en bloc”
- Ataxic to head motions
- Inconsistent occasional veering or staggering
- Acutely pulled to side of lesion
  - Stronger veering if eyes closed during the task
- If bilateral, quite ataxic but not to point of cerebellar ataxia
  - Profound loss of balance with eyes closed
Vestibular Examination

- History
- Extraocular movement examination
- Nystagmus examination
- Gait examination
- Manipulation of sensory systems for balance
- Neurologic examination (peripheral sensation, DTR’s, muscle tone, coordination)

Extraocular Movements (EOM)

- Indications for testing: ALWAYS
- If abnormal support CENTRAL DEFICIT
- Smooth pursuit
  - head fixed, eyes tracking object below 1-2 Hz
  - Look for: saccadic interruptions, cogwheeling
- Saccade
  - head fixed, rapid repositioning of eyes to refoveate
  - Look for: velocity, accuracy, disconjugate motion
- Vestibular-Ocular Reflex Cancellation
  - head/object moving in phase

Clinical VOR Testing:

VOR slow & VOR fast (head thrust)

- Patient sitting, staring at distinct object 18” away, describe test to patient.
- Flex patient’s head forward 30 degrees
- Hold patient’s head firmly and gently turn side to side at first at slow speeds
  - watch for any loss of smoothness: corrective saccades
- Quickly thrust right or left and observe
  - direction of head motion during thrust that produces corrections in abnormal side
Nystagmus Examination

- Spontaneous nystagmus: observe in sitting
- After Head Shake Test
- Positional or Positioning Testing

Positional Nystagmus
TESTING FOR BPPV

- Maneuvers
  - Dix-Hallpike (for anterior and posterior canals)
  - Roll test (for horizontal canal)

- Abnormal Test
  - Latency (3-5 sec)
  - Crescendo/decrescendo onset/duration
  - c/o Dizziness with Nystagmus observed
  - Fatigues within 60 sec.
  - Habituates across repetition
  - Nystagmus reverses on sitting-up

TESTING FOR UNILATERAL HYPOFUNCTION

- Examination Tools
  - DVA testing
  - Head thrust
  - After head- shake
  - Fukada step test
  - CTSB / CDP

- Abnormal Test
  - Potential history of vestibular crisis (meatus)
  - Decrement of visual acuity with head motion
  - Positive head thrust test (impaired VOR)
  - Post head- shake nystagmus
  - Rotation during Fukada (typically not perceived)
  - Postural stability deficits during vestibular demanding conditions
TESTING FOR BILATERAL HYPOFUNCTION / LOSS

- Examination Tools
  - DVA testing
  - Fukada step test
  - CTSB / CDP

- Abnormal Test
  - Potential history of severe infection with antibiotic treatment
  - Profound decrement of visual acuity with head motion
  - Positive head thrust test bilaterally (impaired VOR)
  - Profound rotation during Fukada if they don’t fall
  - Profound postural stability deficits during vestibular demanding conditions

Cervical Dizziness

- Diagnosis by exclusion
- Limited ROM with pain
- Reproduce dizziness with
  - Body on head motion
  - Vibration to neck muscles
  - Trigger point palpation especially SCM/suboccipitals

Vertebrobasilar Insufficiency (VBI)

- PT must be careful not to exacerbate
- Sitting Vertebral Artery screening prior to Dix-Hallpike or BPPV treatments ?
  - Only to 30 degrees extension/45 degrees rotation
- Symptoms associated with VBI
  - Visual dysfunction (69%)
  - Drop attacks(31%)
  - Unsteadiness/incoordination, Extremitry weakness (21%)
  - Confusion (17%)
  - Headache, hearing loss (14%)
  - LOC, extremity numbness, dysarthria, tinnitus (11%)
  - Perioral numbness (5%)
Diagnosis and Treatment of BPPV

Test Dix-Hallpike or Sidelying Test

- Positive Torsional with Upbeat: Posterior Canal
  - Transient (<60 sec): Canalithiasis
    - Determine side: Right Torsional: R; Left Torsional: L
      - CRT
  - Persistent: Cupulolithiasis
    - Determine side: Right Torsional: R; Left Torsional: L
      - Liberatory

- Positive Torsional with Downbeat: Anterior Canal
  - Transient (<60 sec): Canalithiasis
    - Determine side: Right Torsional: R; Left Torsional: L
      - CRT
  - Persistent: Cupulolithiasis
    - Determine side: Right Torsional: R; Left Torsional: L
      - Modified Liberatory r/o central

- Positive Horizontal: Horizontal Canal
  - Geotrophic: Canalithiasis (<5 min)
    - Determine side: Most intense Nystagmus + Hx
      - Modified CRT "log Roll"
  - Ageotrophic: Cupulolithiasis (persistent)
    - Determine side: Most Symptomatic Nystagmus + Hx
      - Modified Brandt-Daroff r/o central

- Negative: Complete Roll Test
  - Follow indications for nystagmus type
Vestibular Examination Labs
PT 7220

Perform the following tests on your partner and describe the deficits that you would likely see with BPPV or unilateral vestibular loss.

Precautionary tests

Seated and Supine vertebral artery tests

Oculomotor Examination

Cranial nerve testing / Smooth pursuit:
Holding the patient’s head stationary, have the patient follow your finger so that they look 30 degrees to the right, left, up, and down. Observe how smoothly they follow your finger. An abnormality is indicated if the patient follows your finger with saccadic eye movements. Note in which direction that this occurs. Your finger should be 18-24” away from the patient’s face throughout the test and should trace an “H” pattern. Testing each eye individually may give additional insight into visual field integrity.

Saccadic eye movement:
Holding the patient’s head stationary, hold your finger 15 degrees to one side of your nose. Have the patient quickly change their gaze from your nose to your finger. Do this several times to the right, left, up, and down. Observe for re-fixation between the two targets. Note if the patient overshoots or undershoots the target and the direction that this occurs. The patient should be able to focus with one or two saccades. More than 2 saccades needed to reach a target suggests an abnormality.

Positional testing (see attached sheet)

Dix Hallpike
Roll test

VOR Testing

Static and Dynamic Visual Acuity
Follow the guidelines for distance provided by the visual acuity chart you are using. While in a stationary head position (sitting or standing), have the patient read the smallest line possible (lowest) and note that acuity. Then have the patient tilt their head forward 30 degrees and either actively or passively have the patient’s head move from side to side at a frequency of approximately 2 Hz. While the patient’s head is moving, have the patient read the smallest line possible (lowest) and note that acuity. Degradation of acuity during dynamic movement by more than 2 lines is indicative of VOR gain alterations.
VOR to slow and fast head movements (head thrust)

**SLOW:** Grasp the patient’s head firmly with one hand on each side of their head. Tilt their head forward so that the horizontal semi-circular canals are level in the horizontal plane. Instruct the patient to look at your nose. Slowly move the patient’s head 30 degrees side to side observing the patient’s ability to maintain visual fixation on your nose.

**FAST:** It is imperative that the patient be informed that you will moving their head very quickly, but only a small amount. They should be instructed to relax and not to blink. If you noted that they have any limitations in cervical spine mobility or pain, this test should be performed with extreme caution or should be deferred.

Grasp the patient’s head firmly with one hand on each side of their head. Tilt their head forward so that the horizontal semi-circular canals are level in the horizontal plane. Instruct the patient to look at your nose. Slowly move the patient’s head 30 degrees side to side observing the patient’s ability to maintain visual fixation on your nose and testing to make sure that they are relaxed. Then suddenly move the patient’s head in one direction and stop. The head movement should be of a small amplitude and held at the end of the motion. Observe the patient’s ability to maintain visual fixation. You should note if the patient makes corrective saccades to re-fixate on your nose and the direction of head motion that elicits the re-fixation saccades. You should repeat this procedure with the patient fixating on a distant target.

---

**Head shaking**

With Frenzel lenses or infrared goggles in place, either actively or passively have the patient turn their head side to side at a speed of >2 Hz for approximately 30 seconds. At the completion of the 30 seconds, have the patient hold their head stable and make sure their eyes are wide open. Observe for any nystagmus. The presence of nystagmus after head shaking is an abnormal finding and may suggest some degree of vestibular imbalance or loss (assuming not central pathology).
VOR cancellation
Grasp the patient’s head firmly with one hand on each side of their head. Tilt their head forward so that the horizontal semi-circular canals are level in the horizontal plane. Instruct the patient to look at your nose. Slowly move the patient’s head 30 degrees side to side while you move in the same direction (so that your face remains directly in front of the patient’s face). Note if the patient can maintain visual fixation or has to make saccadic eye movements. Additionally, you should note any restrictions in cervical spine ROM or pain produced with these low velocity movements.

Clinical Balance Tests

Category 4 and 5 of the CTSIB; CTSIB with head motion

Fukada step test
This test assesses postural control during marching in place, a self-initiated weight-shifting and postural-control task. The patient marches in place for 50 steps, first with the eyes open and then with the eyes closed, on a floor grid or markings on the floor that allow the distance the patient moves from the starting position during each trial to be quantified. Patients with unilateral vestibular dysfunction often turn excessively toward their involved side during the eyes-closed trial whereas patients with bilateral vestibular loss typically fall during this test.
Functional Gait Assessment

Requirements: A marked 6-m (20-ft) walkway that is marked with a 30.48-cm (12-in) width.

1. GAIT LEVEL SURFACE

Instructions: Walk at your normal speed from here to the next mark (6 m [20 ft]).

Grading: Mark the highest category that applies.

(3) Normal--Walks 6 m (20 ft) in less than 5.5 seconds, no assistive devices, good speed, no evidence for imbalance, normal gait pattern, deviates no more than 15.24 cm (6 in) outside of the 30.48-cm (12-in) walkway width.

(2) Mild impairment--Walks 6 m (20 ft) in less than 7 seconds but greater than 5.5 seconds, uses assistive device, slower speed, mild gait deviations, or deviates 15.24-25.4 cm (6-10 in) outside of the 30.48-cm (12-in) walkway width.

(1) Moderate impairment--Walks 6 m (20 ft), slow speed, abnormal gait pattern, evidence for imbalance, or deviates 25.4-38.1 cm (10-15 in) outside of the 30.48-cm (12-in) walkway width. Requires more than 7 seconds to ambulate 6 m (20 ft).

(0) Severe impairment--Cannot walk 6 m (20 ft) without assistance, severe gait deviations or imbalance, deviates greater than 38.1 cm (15 in) outside of the 30.48-cm (12-in) walkway width or reaches and touches the wall.

2. CHANGE IN GAIT SPEED

Instructions: Begin walking at your normal pace (for 1.5 m [5 ft]). When I tell you "go," walk as fast as you can (for 1.5 m [5 ft]). When I tell you “slow,” walk as slowly as you can (for 1.5 m [5 ft]).

Grading: Mark the highest category that applies.

(3) Normal--Able to smoothly change walking speed without loss of balance or gait deviation. Shows a significant difference in walking speeds between normal, fast, and slow speeds. Deviates no more than 15.24 cm (6 in) outside of the 30.48-cm (12-in) walkway width.

(2) Mild impairment--Is able to change speed but demonstrates mild gait deviations, deviates 15.24-25.4 cm (6-10 in) outside of the 30.48-cm (12-in) walkway width, or no gait deviations but unable to achieve a significant change in velocity, or uses an assistive device.

(1) Moderate impairment--Makes only minor adjustments to walking speed, or accomplishes a change in speed with significant gait deviations, deviates 25.4-38.1 cm (10-15 in) outside the 30.48-cm (12-in) walkway width, or changes speed but loses balance but is able to recover and continue walking.

(0) Severe impairment--Cannot change speeds, deviates greater than 38.1 cm (15 in) outside 30.48-cm (12-in) walkway width, or loses balance and has to reach for wall or be caught.
3. **GAIT WITH HORIZONTAL HEAD TURNS**

Instructions: *Walk from here to the next mark 6 m (20 ft) away. Begin walking at your normal pace. Keep walking straight; after 3 steps, turn your head to the right and keep walking straight while looking to the right. After 3 more steps, turn your head to the left and keep walking straight while looking left. Continue alternating looking right and left every 3 steps until you have completed 2 repetitions in each direction.*

Grading: Mark the highest category that applies.

(3) Normal--Performs head turns smoothly with no change in gait. Deviates no more than 15.24 cm (6 in) outside 30.48-cm (12-in) walkway width.

(2) Mild impairment--Performs head turns smoothly with slight change in gait velocity (eg, minor disruption to smooth gait path), deviates 15.24-25.4 cm (6-10 in) outside 30.48-cm (12-in) walkway width, or uses an assistive device.

(1) Moderate impairment--Performs head turns with moderate change in gait velocity, slows down, deviates 25.4-38.1 cm (10-15 in) outside 30.48-cm (12-in) walkway width but recovers, can continue to walk.

(0) Severe impairment--Performs task with severe disruption of gait (eg, staggers 38.1 cm [15 in] outside 30.48-cm (12-in) walkway width, loses balance, stops, or reaches for wall).

4. **GAIT WITH VERTICAL HEAD TURNS**

Instructions: *Walk from here to the next mark (6 m [20 ft]). Begin walking at your normal pace. Keep walking straight; after 3 steps, tip your head up and keep walking straight while looking up. After 3 more steps, tip your head down, keep walking straight while looking down. Continue alternating looking up and down every 3 steps until you have completed 2 repetitions in each direction.*

Grading: Mark the highest category that applies.

(3) Normal--Performs head turns with no change in gait. Deviates no more than 15.24 cm (6 in) outside 30.48-cm (12-in) walkway width.

(2) Mild impairment--Performs task with slight change in gait velocity (eg, minor disruption to smooth gait path), deviates 15.24-25.4 cm (6-10 in) outside 30.48-cm (12-in) walkway width or uses assistive device.

(1) Moderate impairment--Performs task with moderate change in gait velocity, slows down, deviates 25.4-38.1 cm (10-15 in) outside 30.48-cm (12-in) walkway width but recovers, can continue to walk.

(0) Severe impairment--Performs task with severe disruption of gait (eg, staggers 38.1 cm [15 in] outside 30.48-cm (12-in) walkway width, loses balance, stops, or reaches for wall).

5. **GAIT AND PIVOT TURN**

Instructions: *Begin with walking at your normal pace. When I tell you, "turn and stop," turn as quickly as you can to face the opposite direction and stop.*

Grading: Mark the highest category that applies.

(3) Normal--Pivot turns safely within 3 seconds and stops quickly with no loss of balance.

(2) Mild impairment--Pivot turns safely in >3 seconds and stops with no loss of balance, or pivot turns safely within 3 seconds and stops with mild imbalance, requires small steps to catch balance.

(1) Moderate impairment--Turns slowly, requires verbal cueing, or requires several small steps to catch balance following turn and stop.

(0) Severe impairment--Cannot turn safely, requires assistance to turn and stop.
6. STEP OVER OBSTACLE

Instructions: Begin walking at your normal speed. When you come to the shoe box, step over it, not around it, and keep walking.

Grading: Mark the highest category that applies.

(3) Normal--Is able to step over 2 stacked shoe boxes taped together (22.86 cm [9 in] total height) without changing gait speed; no evidence of imbalance.

(2) Mild impairment--Is able to step over one shoe box (11.43 cm [4.5 in] total height) without changing gait speed; no evidence of imbalance.

(1) Moderate impairment--Is able to step over one shoe box (11.43 cm [4.5 in] total height) but must slow down and adjust steps to clear box safely. May require verbal cueing.

(0) Severe impairment--Cannot perform without assistance.

7. GAIT WITH NARROW BASE OF SUPPORT

Instructions: Walk on the floor with arms folded across the chest, feet aligned heel to toe in tandem for a distance of 3.6 m [12 ft]. The number of steps taken in a straight line are counted for a maximum of 10 steps.

Grading: Mark the highest category that applies.

(3) Normal--Is able to ambulate for 10 steps heel to toe with no staggering.

(2) Mild impairment--Ambulates 7-9 steps.

(1) Moderate impairment--Ambulates 4-7 steps.

(0) Severe impairment--Ambulates less than 4 steps heel to toe or cannot perform without assistance.

8. GAIT WITH EYES CLOSED

Instructions: Walk at your normal speed from here to the next mark (6 m [20 ft]) with your eyes closed.

Grading: Mark the highest category that applies.

(3) Normal--Walks 6 m (20 ft), no assistive devices, good speed, no evidence of imbalance, normal gait pattern, deviates no more than 15.24 cm (6 in) outside 30.48-cm (12-in) walkway width. Ambulates 6 m (20 ft) in less than 7 seconds.

(2) Mild impairment--Walks 6 m (20 ft), uses assistive device, slower speed, mild gait deviations, deviates 15.24-25.4 cm (6-10 in) outside 30.48-cm (12-in) walkway width. Ambulates 6 m (20 ft) in less than 9 seconds but greater than 7 seconds.

(1) Moderate impairment--Walks 6 m (20 ft), slow speed, abnormal gait pattern, evidence for imbalance, deviates 25.4-38.1 cm (10-15 in) outside 30.48-cm (12-in) walkway width. Requires more than 9 seconds to ambulate 6 m (20 ft).

(0) Severe impairment--Cannot walk 6 m (20 ft) without assistance, severe gait deviations or imbalance, deviates greater than 38.1 cm (15 in) outside 30.48-cm (12-in) walkway width or will not attempt task.
9. AMBULATING BACKWARDS

Instructions: *Walk backwards until I tell you to stop.*

Grading: Mark the highest category that applies.

(3) Normal--Walks 6 m (20 ft), no assistive devices, good speed, no evidence for imbalance, normal gait pattern, deviates no more than 15.24 cm (6 in) outside 30.48-cm (12-in) walkway width.

(2) Mild impairment--Walks 6 m (20 ft), uses assistive device, slower speed, mild gait deviations, deviates 15.24-25.4 cm (6-10 in) outside 30.48-cm (12-in) walkway width.

(1) Moderate impairment--Walks 6 m (20 ft), slow speed, abnormal gait pattern, evidence for imbalance, deviates 25.4-38.1 cm (10-15 in) outside 30.48-cm (12-in) walkway width.

(0) Severe impairment--Cannot walk 6 m (20 ft) without assistance, severe gait deviations or imbalance, deviates greater than 38.1 cm (15 in) outside 30.48-cm (12-in) walkway width or will not attempt task.

10. STEPS

Instructions: *Walk up these stairs as you would at home (ie, using the rail if necessary). At the top turn around and walk down.*

Grading: Mark the highest category that applies.

(3) Normal--Alternating feet, no rail.

(2) Mild impairment--Alternating feet, must use rail.

(1) Moderate impairment--Two feet to a stair; must use rail.

(0) Severe impairment--Cannot do safely.

**TOTAL SCORE: _____ MAXIMUM SCORE 30**

Reference:

Reliability, internal consistency, and validity of data obtained with the functional gait assessment.
Dix Hallpike test: (for the posterior and anterior canals)
After performing vertebral artery tests to rule out VBI, have the patient sitting in long sitting on a treatment table. Turn the patient’s head to 45 degrees and extend 30 degrees/ Stand either to the side of them or behind them so that you can safely assist them in moving quickly from long sitting to supine with the head in the rotated / extended position. Ask the patient to keep their eyes open and observe for nystagmus as well as note the temporal behavior of the signs and symptoms (latency, duration). Then quickly return the patient to the starting position, observing for nystagmus and subjective complaints. The test is then repeated on the other side. The ear that is inferior is the ear that is being tested.

Roll Test: (for horizontal canal BPPV)
A. With the patient lying supine, position them so that their head is flexed 20-30 degrees (which brings the horizontal canal into a vertical position relative to gravity). B. Move the patients head quickly 90 degrees to one direction and observe for nystagmus and subjective complaints. C. Slowly move the head back to neutral. D. Move the patients head quickly 90 degrees in the other direction and observe for nystagmus and subjective complaints. Note: In horizontal canal BPPV, both horizontal canals are stimulated during head turning in either direction. This makes localization sometimes challenging. The general rule is that the nystagmus and symptoms are stronger when rotating to that side.
<table>
<thead>
<tr>
<th>Examinations and Tests</th>
<th>Descriptor</th>
<th>CNS</th>
<th>PNS*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertebral Artery Test</td>
<td>Seated: Patient seated on stool, extend cervical spine and rotate body either direction, hold head still and in extension. Supine.</td>
<td>n/a:</td>
<td>n/a</td>
</tr>
<tr>
<td>Cranial nerve testing</td>
<td>Cranial nerves testing III, IV, VI</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Smooth Pursuit</td>
<td>H test-finger 18”-24” away-patient eyes should follow</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Saccadic Eye Movement</td>
<td>Patient eyes move from PT’s nose to finger-patient’s eyes should accurately re-fixate to each point</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Dix Hall Pike</td>
<td>For posterior and anterior canals: seated to supine and back with head in rotation and extension. Observe for nystagmus (latency, pattern, fatigue)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Head roll</td>
<td>For horizontal Canals: supine, head at 30˚, patient turns head first to one side, then the other. Observe for nystagmus.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Static Visual Acuity</td>
<td>VOR testing: patient reads smallest line possible, with glasses or contacts. Compare with DVA</td>
<td>?</td>
<td>X</td>
</tr>
<tr>
<td>Dynamic Visual Acuity (DVA)</td>
<td>Visual acuity test: tilts head to 30˚, and moves head side to side &gt; 2 Hz, should be able to read within 2 lines of static test</td>
<td>?</td>
<td>X</td>
</tr>
<tr>
<td>Head Thrust</td>
<td>VOR to SLOW and FAST head movements: SLOW-head tilted to 30˚: PT holds patients head and slowly moves it side to side observing ability for visual fixation on your nose. For FAST- begin as in slow test, then suddenly move the patient’s head on one direction and stop. Observe for corrective saccades.</td>
<td>?</td>
<td>X</td>
</tr>
<tr>
<td>Head Shake</td>
<td>Patients eyes closed, actively or passively move head side to side ≥2Hz, for 30 sec. Observe for nystagmus</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>VOR Cancellation</td>
<td>Head at 30˚, patient focuses on your nose, you move side to side in same direction as the patients head. Patient should maintain focus on your nose. Observe for saccadic eye movements.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>VSR</td>
<td>CTSIB category 4 and 5, CTSIB with head movement, Fukada step test</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

*in absence of CNS signs
Current Theories of BPPV

• Cupulolithiasis
  • histologic, some cases present with persistent sx

• Canalithiasis
  • duration/fatigue, no sx if slow position change, latency to onset of nystagmus

Dix-Hallpike Testing for BPPV

• Maneuver
  • holding pt’s head 45 degrees to right or left
  • rapidly lie patient down into 30 degree extension
  • stay in position 60 seconds

• Abnormal Test
  • Latency (3-5 sec)
  • Crescendo/decrescendo onset/duration
  • c/o dizziness with nystagmus observed
  • Fatigues within 60 sec.
  • Habituates across repetition
  • Nystagmus reverses on sitting-up

• Differential Dx: Vertebral artery testing
Brandt-Daroff Exercise

- Instructions
  - Rapidly lie on affected side, wait for dizziness to resolve plus 20 sec., sit-up wait for dizziness to resolve plus 20 sec., lie on opposite side wait for dizziness to resolve or if no symptoms just 20 sec.

- Rationale
  - canalith dispersion or habituation

- Expectations
  - improvement days to weeks (4-6)

- Can be viewed as self ROM for vestibular system
Brandt-Daroff (cont.)

- Indications
  - Classic BPPV
    - posterior or anterior canal cupulo or canalithiasis
  - Positional elicited dizziness with evidence of habituation

- contraindications
  - severe back/neck restrictions
  - +VBI, +neurologic S&S

- Modifications
  - keep head in center during maneuver: horizontal
  - log-roll adaptation in supine

CANALITH REPOSITIONING MANEUVERS

Epley maneuver
Figure 7. Right CRT. A, right head hanging position; B, leftward roll; C, further leftward roll; D, sitting up.

Figure 8. Movement of canaliths in the right posterior canal during the right Dix-Hallpike maneuver and right CRT. A, sitting with head turned rightward; B, right head hanging position; C, leftward roll; D, sitting up.
Epley Repositioning Indications Vs Contraindications

**INDICATIONS**
- + Classic Dix-Hallpike (< >, fatigue, reversal, hab.)
- + Nystagmus
  » torsional/upbeat: posterior canal
  » torsional/downbeat: anterior canal

**CONTRAINDICATIONS**
- + sitting vertebral artery test
- hx of detached retina (no oscillation)
- hx of seizures
- neck/low back dysfunction
  » modify with trendelenburg bed, increase log rolling Vs cervical rotation demands

“Maybe it’s your inner ear.”
**HORIZONTAL CANAL REPOSITIONING TREATMENTS**

**Horizontal canal repositioning treatment (BBQ roll) - Canalithiasis**

A. The patient lies supine with their head flexed forward 30 degrees. The head is turned quickly to the side to position the affected ear down (shown here for a right HC BPPV).
B. The patient’s head is then turned slowly away from the affected ear until the face is pointed up. This position is sustained for at least 15 seconds or until the symptoms subside.
C. The patient then turns the head so that the affected ear is up. This position is sustained for at least 15 seconds or until the symptoms subside.
D. Keeping the head in the rotated position, the patient turns to side-lying. From the side-lying position, the patient then rotates their body and head together to get into the prone position. Be sure to keep the head in the flexed position.
E. To finish, the patient can do one of three things (in order from easiest to hardest)
   a. drop their legs off the edge of the bed, and stand up from the prone position.
   b. assume the quadraped position and transition to sitting on the edge of the plinth.
   c. Roll from the prone position back to supine with the head rotated to the affected side (as is illustrated in the figure).

**Modified Brandt-Daroff for HC BPPV- Cupulolithiasis**

A. The patient lies supine with their head flexed forward 30 degrees.
B. The head is turned quickly to the side to position the affected ear down (shown here for a left HC BPPV).
C. The head is turned quickly to the opposite side to position the affected ear up. This process can be repeated 2 to 3 times to dislodge the debris and then followed by a BBQ roll for repositioning.
**BRANDT-DAROFF EXERCISE**

Brandt, T and Daroff, RB

- **Instructions**
  Rapidly lie on affected side, wait for dizziness to resolve plus 20 sec., sit-up wait for dizziness to resolve plus 20 sec., lie on opposite side wait for dizziness to resolve or if no symptoms just 20 sec.

- **Rationale**
  Canalith dispersion or habituation. Can be viewed as self ROM for vestibular system

- **Indications**
  Posterior or anterior SCC cupulo or canalithiasis
  Positional elicited dizziness with evidence of habituation

- **Contraindications**
  Severe back/neck restrictions
  +VBI, +neurologic S&S

- **Modifications**
  Keep head in center during maneuver: horizontal SCC
  Log-roll adaptation in supine
Treatment of Vestibular Hypofunction

Indications for Gaze Stabilization

- Diagnoses:
  - s/p Acoustic Neuroma
  - s/p Vestibular Neuritis
  - Ototoxicity
  - “burned-out” Meniere's
- PT Diagnoses:
  - Unilateral>Bilateral
  - Peripheral-Central
- Impairments:
  - Blurry vision (Oscillopsia), nystagmus consistent with poorly compensated vestibular system

ADAPTATION EXERCISES: Gaze Stabilization Drills

- Exercise prescription of long exposure (1-2min.) of one distinct motion compared to habituation

- Rationale: Facilitates the healing process the central nervous system undergoes in the presence of a partial vestibular loss.
  - Neurophysiologic adaptation of the gain (sensitivity) of vestibular nuclei and the interconnections with the cerebellum
  - Head/eye motion are mandatory
**VOR Adaptation Exercises**

- Start in sitting and progress to heel toe standing as able
- Stare at a focus point on the wall, initially no more than 3-5 feet away, so you can see it clearly.
- Rotate your head side to side, slowly at first to keep the object clear, then gradually as quickly as possible while still keeping the word or letter in focus. Repeat vertically.
- Continue for 1-2 minutes / 3-5 daily.

**VORX1 & VORX2 Adaptation**

**INDICATIONS**
- + subjective c/o oscillopsia
- >2-3 line deterioration on dynamic visual acuity test
- + head thrust abnormality
- + motion sensitivity to repetitive head motions
- UVL > BVL > CENTRAL

**CONTRAINdications**
- severe visual acuity loss
- severe cervical dysfunction with c/o pain despite modifications

**VOR/VSR Progression**

- Sitting, <1 min, plain background, 2-3X
- Standing*, 2 min H&V, 5X/day
- Standing*, 2 min H&V, 5X/day, busy target
- Near/far/H/V 1 min each, 4X/day
- VORX2 H/V 1 min each, 4X/day
- VORX1, VORX2, busy target 4X/day while walking

(S. Herdman, PT, PhD)
GAZE COMPENSATION EXERCISES

• Process by which the balance system recovers when there is a permanent and more complete loss to the vestibular/balance system
• It requires facilitating alternate pathways to "get the job done" and lots of exposure to errors to stimulate reorganization
• Gaze stabilization: other eye motions
• Balance: other sensory inputs & increased motoric demands

GAZE COMPENSATION EXERCISES

• Active eye-head movements between targets (Saccade Facilitation)
  • look quickly between targets focusing first with eyes then with a head motion
• Imaginary targets (Central Preprogramming Facilitation)
  • Stare at target, close eyes imagining focus point and turn your head slightly trying to maintain target
• Enhancing COR (Cervical Ocular Reflex)
  • turn head slowly while trying to focus on object

GAZE Compensation

• May need to start supine/sit
• Start with minimal stimulation
  • thumb
  • card
  • word
• Increase to busy visual backgrounds
  • checkerboard
• Patient may be dizzy
• Don’t forget musculoskeletal treatment of neck/HA
HABITUATION

- “A reduction in pathologic response to a specific movement brought about by repeated exposure to the provocative stimulus”
- 2-4 specific movements
- Sufficient Intensity
  - speed and range of movement
  - no greater than 2-3/5 subjective severity
- Repetitions: 3-5X, 2-3 times daily

Indications vs contraindications

- **INDICATIONS**
  - Abnormal Motion Sensitivity Testing with evidence of habituation or improved postural stability across repetition
  - Patient compliance & motivation
  - Peripheral-Central-Mixed findings
- **CONTRAINDICATIONS**
  - + Sitting vertebral artery test (esp. elderly)
  - If change of hearing, pain &/or discharge from ear
  - If sx occur when moving orthostatically (check BP)
    - In elderly, avoid quick demands orthostatically

Fluctuating or Unstable Vestibular Problems

- Meniere’s:
  - low salt diet, medical management, generalized fitness, treat like UVL if stabilizes.
- Migraine:
  - diet, stress management, aerobic fitness
- Perilymph fistula:
  - pressure, sound, valsalva, altitude changes provoke
  - if suspected place in UVL, often worsens=DC
  - bed rest 2-3 weeks
Central Vestibular

- Longer Rehabilitation expected
  - Improvement over months to years often
- Pathways for adaptation often impaired
  - Habitation vs adaptation vs. compensation?
  - Progression often much slower
- Generally motoric involvement much more extensive
  - Ankle, hip, and stepping retraining
  - Accuracy, Holding, and ROM deficits

Other

- Mal De Debarquement
  - Medical management: Klonopin
  - Otolithic Habitation drills
    - tilt position, acceleration/deceleration
  - Somatosensory/surface orientation drills
  - Sensory flexibility drills
  - ?VORX1?
  - ?stress management?

- Somatoform
  - medical management
  - Conversion: intensive inpatient team approach

Reducing Visual Motion Sensitivity

- Education
- Behavior Management
  - relaxation
  - surface orienting
  - decreasing optic flow
- Systematic Desensitization
- Balance Retraining
  - use of somatosensory and vestibular cues
Cervical Vertigo

• ROM/stretching
• Cervical Stabilization Routines
• Deep tissue massage
• Soft tissue mobilization
  – Travel trigger point therapy
  – Strain Counter strain
  – Muscle energy
  – Mobilization

Conclusions

• Dizziness is common problem and vestibular dysfunction is common etiology
• Compensation has been found to require visuomotor experiences
• Exercise has been shown effective at facilitating recovery
• There are a number of effective treatment options based on specific impairments
PRACTICAL EXAMINATION #1

1. You are examining a patient who 2 weeks ago developed sudden onset of severe vertigo with nausea and vomiting continuously for 3 days. The symptoms slowly subsided over the next week. Currently the patient does not need assistance to walk however notes that rapid head movements provoke imbalance and nausea. The patient has no complaints of auditory symptoms.

a. Describe the additional assessment procedures you would use to make a determination of whether the origin of the symptoms is peripheral or central in nature.

The student should describe the performance of an extraocular movement exam including smooth pursuits, saccades, and cranial nerve assessment (at minimum CN III, IV, VI). In addition, the student could mention VOR cancellation, sensory and motor examination of the face, trunk, and extremities, and cerebellar tests. The student should be able to indicate that deficits in smooth pursuits, saccadic eye movements, VOR cancellation, RAMS, finger to nose, and other sensory/motor deficits in cranial nerve or other distributions are indicative of central vestibular pathology.

b. Perform an appropriate initial treatment for this peripheral unilateral vestibular hypofunction (assume L sided hypofunction).

The student should demonstrate the performance of VOR exercises in horizontal and vertical planes. The student should demonstrate practice of static and dynamic balance tasks with head motion and altered sensory situations. Students may also include habituation exercises (ie Brandt Daroff).

2. You are examining a patient WITH complaints of positional vertigo. On examination you note a positive Dix Hallpike test to the right. During this test, you note the patient to have right torsional and upbeatng nystagmus with a latency to onset of 5 sec and a duration of 20 seconds.

a. Explain what type of BPPV this is and what canal is affected.

b. Perform an appropriate treatment technique for this patient and describe how you will tell if your treatment was successful.

Several options are possible – 1) CRP starting going to the right. 2) Brandt Daroff (although I wouldn’t give full credit for this) 3) Semont.

GRADING FOR LOCALIZATION AND TYPE OF BPPV

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unable to provide rationale</td>
<td>Provides sound rationale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GRADING FOR TECHNIQUE PERFORMANCE

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unable to perform</td>
<td>Cannot identify perform all aspects of technique even with prompting</td>
<td>Performs technique appropriately but requires prompting</td>
<td>Performs technique correctly, no prompting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. You are examining a patient who 2 weeks ago developed sudden onset of severe vertigo with nausea and vomiting continuously for 3 days. The symptoms slowly subsided over the next week. Currently the patient does not need assistance to walk however notes that rapid head movements provoke imbalance and nausea. The patient has no complaints of auditory symptoms.

   a. Describe the additional assessment procedures you would use to make a determination of whether the origin of the symptoms is peripheral or central in nature.

   b. Perform an appropriate initial treatment for this peripheral unilateral vestibular hypofunction (assume L sided hypofunction).

2. You are examining a patient WITH complaints of positional vertigo. On examination you note a positive Dix Hallpike test to the right. During this test, you note the patient to have right torsional and upbeat nystagmus with a latency to onset of 5 sec and a duration of 20 seconds.

   a. Explain what type of BPPV this is and what canal is affected.

   b. Perform an appropriate treatment technique for this patient and describe how you will tell if your treatment was successful.
1. You are treating a patient with left horizontal canal canalithiasis.

a. **Perform an appropriate treatment technique for this problem.**
The student should perform the BBQ roll starting with the left ear down.

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   - Unable to perform
   - Cannot identify perform all aspects of technique even with prompting
   - Performs technique appropriately but requires prompting
   - Performs technique correctly, no prompting

b. **Describe the examination process required to distinguish a left horizontal canal canalithiasis from canalithiasis in the left anterior canal.**

   The student should indicate that they would perform the Dix Hallpike test and the roll test. They should also mention the observation for torsional nystagmus as opposed to straight geotropic nystagmus. They may also mention the elicitation of nystagmus and symptoms with testing in both directions of rolling as opposed to only one direction with the Dix Hallpike test.

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   - Unable to perform
   - Cannot identify all aspects of the problem even with prompting
   - Identifies all aspects of problem but requires prompting
   - Answers correctly, no prompting

2. You are examining a patient with complaints of oscillopsia. When walking or running, the patient notes that he cannot read street signs and must stop for things to be in focus. He has no complaints of positional vertigo and cannot recall any provoking episode that started the symptoms.

a. **Perform the appropriate examination procedures based on these history findings to distinguish the side of the pathology.**

   - Several options are possible – 1) static and dynamic visual acuity 2) Fukada step test 3) after headshaking nystagmus 4) Head thrust

   **Rationale:** History suggestive of functional VOR problems. All clinical tests are targeted at eliciting some sign of imbalance in vestibular function. Note: the students should mention more than one test and should be able to explain how to localize the lesion/hypofunction.

   **GRADING FOR TECHNIQUE PERFORMANCE**

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   - Unable to perform
   - Cannot identify perform all aspects of technique even with prompting
   - Performs technique appropriately but requires prompting
   - Performs technique correctly, no prompting

   **GRADING FOR RATIONALE / LOCALIZATION OF PROBLEM**

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   - Unable to provide rationale
   - Provides sound rationale
PRACTICAL EXAMINATION #2

1. You are treating a patient with left horizontal canal canalithiasis.
   a. Perform an appropriate treatment technique for this problem.
   
   b. Describe the examination process required to distinguish a left horizontal canal canalithiasis from canalithiasis in the left anterior canal.

2. You are examining a patient with complaints of oscillopsia. When walking or running, the patient notes that he cannot read street signs and must stop for things to be in focus. He has no complaints of positional vertigo and cannot recall any provoking episode that started the symptoms.
   a. Perform the appropriate examination procedures based on these history findings to distinguish the side of the pathology.
   
   b. Provide the rationale for the technique you select.
### Competency: Able to evaluate and treat patients with vestibular and/or balance deficits.

<table>
<thead>
<tr>
<th>Performance Criteria:</th>
<th>Date/Validation method</th>
<th>Initials of tester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performs appropriate examination procedures to include but not limited to:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Interview (HPI, PMH, ROS, Dx)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Subjective complaints (on VAS or rate 0-10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Vertigo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Dizziness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Disequilibrium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Oscillopsia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Awareness of Disability / Activity &amp; Participation Measures (ie Dizziness Handicap Inventory)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assesses eye movements and VOR/VSR functioning using appropriate tests and measures to include, but not limited to the following:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Ocular alignment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Extraocular movements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Nystagmus (spontaneous/gaze-holding)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Smooth Pursuit eye movements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Saccadic eye movements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. VOR cancellation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. VOR to slow head movements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. VOR to rapid head thrusts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Head-shaking induced nystagmus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Static visual acuity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Dynamic visual acuity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Assesses vestibular function using the appropriate tests to include but not limited to the following:

1. Vertebral Artery Screening Test
2. Dix-Hallpike Maneuver
3. Roll Test
4. Fukuda stepping test

Assesses balance using the appropriate tests to include but not limited to the following:

1. Computerized Posturography (if available) CTSIB
2. Romberg
3. Sharpen Romberg
4. Single-leg stance
5. Gait Analysis (Tandem, with head turns, narrow BOS)
6. Appropriate Standardized Tests
   FR, BBS, TUG, DGI/FGA
7. Berg Balance Test
8. Get up and Go Test

Demonstrates the appropriate application of the following therapeutic treatments:

1. Vestibular adaptation exercises (X1/X2)
2. Habituation exercises
3. Brandt-Daroff exercises
4. Canalith repositioning maneuvers
5. Substitution / Compensation Training

Method of Validation Key: D=Demonstration, S=Simulation C=Cognitive Testing, A=Attendance

Competency Validated by: __________________________________________