PT Diagnosis in Vestibular Rehabilitation

Courtney Hall, PT, PhD
Research Health Scientist
Assistant Professor
Atlanta VAMC
Emory University

Disclosure: Dr. Hall is faculty for the FallProof™ Certification Program

What is meant by a PT diagnosis?

How does a PT diagnosis help?

The PT diagnosis should:
- help you develop a problem list
- tell you what treatment to use
- help you know what the outcome should be

Impact of vestibular dysfunction

Subjective complaints
Vision during head movement
Balance in stance
Balance while moving
Functional activities

Diagnosis | Treatment Options
--- | ---
BPPV | CRT, Liberatory, Brandt-Daroff
UVL | Adaptation/Substitution (Habituation)
peripheral and central at level of nucleus
Bilateral Vestibular Loss | Adaptation/Substitution
Motion Sensitivity | Habituation
Central Vestibular Supranuclear | Habituation

What is Vestibular Rehabilitation?

- A therapeutic treatment approach for individuals with “vestibular disorders”
  - Symptom- and impairment-driven
  - Vestibular and non-vestibular causes
- Treatment includes:
  - Therapeutic exercise, gait and balance training
  - Compensation

Patient selection

<table>
<thead>
<tr>
<th>Appropriate</th>
<th>Inappropriate</th>
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<tbody>
<tr>
<td>- Head or visual motion provoked symptoms</td>
<td>- Episodic or spontaneously fluctuating symptoms</td>
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<tr>
<td>- Balance or gait impairment</td>
<td>- No provocative activity or balance dysfunction</td>
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<td>- Stable central or peripheral lesion</td>
<td>- Progressive central lesion</td>
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<td>- Any age</td>
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Compensation

- Response to a permanent vestibular loss
- Goals of compensation
  - Normalize gaze stability and postural control
  - Static and dynamic conditions
- CNS changes to optimize function

Compensation - static

- Regeneration and re-balancing of the resting activity of the vestibular nucleus
- Occurs in the absence of vision
- Intrinsic property of the neurons

Compensation - dynamic

- Reprogramming of eye movements and postural responses to vestibular stimulation (movements)
- Independent of static compensation
- Requires movement and exposure to stimuli that challenge the system

Mechanisms of Recovery & Change

- VOR/VSR Adaptation
- Habituation
- Substitution
- Limited movement

Adaptation

- Long-term changes in neuronal response of the vestibular system to head movement
  - Retinal slip during head movement induces change
- Goals
  - Gaze stability
  - Postural stability
  - Reduce symptoms

VOR Gain Adaptation

Lisberger, SG. Trends Neurosci 11:147, 1988
Habituation

- Long-term reduction of a response to noxious stimulus through repeated exposure to the provocative stimulus
- Asymmetrical vestibular function leads to sensory mismatch and symptom provocation

Substitution

- The substitution of alternative strategies to replace lost or compromised function
  - VSR
    - Substitution of other sensory systems (vision, somatosensory)
  - VOR
    - COR
    - Pre-programmed eye movements

Substitution

Central pre-programming:
- Can reduce gaze error in predictable tasks
- Minimize decrement in visual acuity during head movements

Substitution strategy – “slow phases”

Note slow phase eye movement in the direction opposite the head thrust
Centrally programmed High Velocity Slow Phase eye movement
Too high for VOR from intact side (in UVH)

Vestibular rehabilitation

- Treatment is determined by:
  - Symptoms
    - Dizziness, imbalance, oscillopsia
  - Impairments
    - Activity limitation, fall risk, postural instability, gaze instability

Vestibular Rehabilitation: Treatment

Adaptation exercises
- Goal to improve VOR gain
- VORx1, x2 exercises: horizontal and vertical
- 60 sec – 120 sec

Substitution exercises
- Goal to substitute for VOR
- Eye-head b/t targets, remembered target
Adaptation exercises

Based on models of VOR adaptation – retinal slip & head movements
→ x1 & x2 viewing exercises

Substitution exercises

• Goal = facilitate compensatory eye movements (pre-programmed saccades or high velocity slow phase)
• Eye-head between targets
• Remembered targets

Exercise Progression

• Duration*
• Speed*
• Background Distraction
• Position
• Distance
• Target size
• Frequency

Considerations

• Image must be stable
• Observe patient’s eyes
• To progress one variable, may need to modify another variable
• Avoid over stimulation
  — Err on the side of caution: “less is more”
• All patients will not progress through all exercises or variables
• Symptoms should not exceed 20 – 30 minutes following HEP

Vestibular Rehabilitation: Treatment

Habituation exercises
• Goal to reduce symptoms to provocative movement
• Dose-related activity
  • 2-3 movements of moderate intensity repeated 5-10 times
• Does generalize if movements are very similar

Vestibular Rehabilitation: Treatment

Balance and gait exercises
• Progressive static balance
  • EO and EC
  • Narrow base of support
  • Altered surfaces
• Progressive gait exercises with and without head movements, altered surface/vision
• Encourage walking program
Management of the patient with vestibular hypofunction or loss

Vestibular Rehabilitation: Treatment options

- For patients with remaining vestibular function
  - Adaptation
  - Substitution
  - Habituation
    - Not effective with BVH
- For patients without vestibular function
  - Adaptation
  - Substitution
    - Induce substitution
  - For patients without vestibular function
    - Adaptation (facilitate central pre-programming)

Expected Outcomes of Vestibular Rehabilitation

- Significant decrease complaints of “dizziness”
- Decrease risk for falls
- Improve SOT
- Improve visual acuity during head movement
- Independent in ADLs
- Resume many normal activities

(1995; Horak et al., 1992; Krebs et al., 1993; Shepard & Telian, 1995; Szturm et al., 1994; Yardley et al., 1998; Herdman et al., 2011)

Progression of exercises and planning of home exercise program

I. Gaze Stabilization

- Signs & symptoms: dizziness or oscillopsia with head motion, poor dynamic visual acuity, restricted activities (e.g., driving, sports)

- Exercise approach: vestibular adaptation and substitution exercises

- Goals: Minimize symptoms with head motion; able to see clearly with head movements for age; return to daily activities

Sample HEP: Initial

VOR x 1 horizontal/vertical
- Near/far
- 1 minute each
- No emphasis on speed of head motion
- Plain background
- 3 - 5x/day
- Walk for endurance
- 20 minutes

Sample HEP: Progression

VOR x 1 horizontal/vertical
- Same as previous
- Emphasize speed
  - “As quickly as you can with target in focus”

Eye-head substitution between targets

horizontal/vertical
- Near
- 2 minutes each
- 5x/day
- Walk for endurance
- 20 - 30 minutes
**Sample HEP: Progression**

**VOR x 1 horizontal/vertical**
- Same as previous
- Busy background (VORx1 with checkerboard)

**Eye-head substitution**
- Same as previous

**Walk for endurance**
- 30 minutes

**Sample HEP: Progression**

**VOR x 1 horizontal/vertical**
- Same as previous

**VOR x 2 (horizontal/vertical)**
- 1 minute each
- 4x/day

**Eye-head substitution**
- Same as previous
- Bow-tie configuration or busy background

**Remembered target (if BVH)**
- Horizontal/vertical
- 1 minute each
- 2x/day

**Progression of gaze stability exercises**

**Progress level of balance challenge:**
- Altered base of support (Romberg, semi tandem, tandem)
- Altered support surface (foam or rocker board)
- Walking forward or backward

**II. Postural control: static and dynamic**

**Signs & symptoms:** Disequilibrium with head motion, loss of balance with head motion or while walking, high risk for falls while walking, restricted activity (e.g., sports, work-related)

**Exercise approach:** Balance and gait exercises (substitution)

**Goals:** Minimize symptoms with head motion; normal use of sensory inputs for balance; reduce fall risk; return to most normal activities

**Treatment Principles**

Manipulate the **task demands** and/or **environmental constraints** in a way that challenges but does not exceed an individual’s intrinsic capabilities.

**Treatment Considerations**

- **Manipulate the task demands**
  - Seated → Standing → Moving
  - Alter base-of-support
  - Self-paced → Externally-paced
  - Add a secondary task:
    - Cognitive
    - Motor

- **Manipulate the environmental constraints**
  - Support surface
    - Firm → Foam → Moving
  - Visual input
    - Reduce → Engage → Distort → Remove
Management of the patient with vestibular hypofunction or loss

**FallProof™ Program Components**

- **Center of Gravity (COG) Control Training**
  - Improve upright position and movement through space
  - Move away from midline with control
- **Multisensory Training**
  - Optimize function of each of the three sensory systems that contribute to balance
- **Postural Strategy Training**
  - Improve each of the three postural strategies (ankle, hip, step) used to maintain balance
- **Gait Pattern Enhancement and Variation**
  - Improve gait pattern so that it is flexible and adaptable
- **Strength and Flexibility**

  D Rose, 2010

**Center of gravity control training: Progression Variables**

- Arm position
- Base of support
- Increase distance
- Increase timing demand
- Add movement sequences
  - Head turns
- Add resistance
- Add concurrent tasks that demand attention
  - Ball toss

**Multisensory training: Progression variables**

- By limiting/removing sensory input, remaining systems work harder
- **Vision** – cue gaze stabilization; disadvantage somatosensory
- **Somatosensory** – disadvantage vision
- **Vestibular** – disadvantage somatosensory and vision

**Postural strategy training: Progression variables**

To elicit different strategies:

- Alter the surface
- Increase distance/speed of sway
- Increase the perturbation

**Gait training: Progression Variables**

- Base of Support
- Gait Pattern (sidestepping, backwards, braiding)
- Start/stop/change speed/change direction
- Stepping over/around/on obstacles of various heights
- Increase Number of Tasks
  - Walking with head turns
  - Various obstacles within an obstacle course
  - Carrying object while walking through obstacle course
  - Add cognitive task

**Treatment Considerations**

- Safety first!
- Encouragement: early success builds confidence
  - Every patient receives home exercise program they can TOLERATE
  - only 3-5 different exercises, especially for OA
  - Maximize the challenge while minimizing the risk
- Follow up PT visits every week with progression / reassessment as appropriate
SAMPLE HOME EXERCISE PROGRAM
1. Practice standing near a counter and balancing. Feel the pressure under the center of your feet.
   - Feet together, then semi-tandem
   - Alternate eyes open/eyes closed for 10-20 seconds at a time.
2. Stepovers (dynamic weight shift)
3. Circle sways (dynamic weight shift feet in place)
4. Modified Single Leg Stance
5. Stand in a corner on a foam cushion. Have a chair in front of you.
   - Practice with eyes open. Add head turns left/right/up/down
   - Practice with eyes closed for _______ seconds at a time.
   - Practice marching in place- eyes open. Add head turns.
6. Practice standing up/sitting down from a standard chair ______ times.
7. Practice walking in hallway. Turn head side to side-focus on targets every time. Turn head up and down-focus on the ceiling and floor.

III. Motion Provoked Dizziness

- Signs & symptoms: dizziness or vertigo with position changes; dizziness with busy visual backgrounds
- Exercise approach: vestibular habituation exercises
- Goals: Minimize symptoms with position change

Treatment Considerations
- Choose moderately stimulating motions (NOT severe)
- Number of repetitions: 3 – 5 for a given motion
- Number of motions: ≤ 4 movements
  - Consider volume of additional exercises of home program
- Frequency: 1 – 2x/day
- Intensity: exercises should be performed with enough intensity (speed/ROM) to bring on mild-moderate amount of dizziness
  - Over time increase intensity of movements to bring on same degree of dizziness

Treatment Precautions
- If symptoms are brought on by moving from heart low to heart high position, check Blood Pressure
- In older adults, avoid exercises which have them stand quickly
- If headache or nausea accompany motion sensitivity, these symptoms will have to be controlled

Exercise examples
- While sitting, turn your head quickly from right to left 5 times. Look in the direction you are turning. Wait for symptoms to subside. Repeat 3 times.
- Lie on your back. Quickly roll to the right side. Wait for symptoms to pass. Return to your back. Quickly roll to left side. Wait for symptoms to pass. Repeat 3 times.
Management of the patient with vestibular hypofunction or loss

When is it time to discharge?

- **Discharge the patient:**
  - Once patient is no longer at risk for fall OR reaches a plateau
  - **AND**
    - Understands importance of continuing HEP
- If patient at risk for falls, consider assistive device
- Follow up in 3 - 6 months

Summary

1. Appropriately used exercises are beneficial
   Cawthorne-Cooksey or generic exercises are not appropriate.
2. Age and time from onset are not factors in recovery
3. Specific deficits benefit from specific exercise approach
   UVH: Adaptation, substitution, habituation, balance & gait
   BVH: Adaptation, substitution, balance & gait
4. Treatment frequency and duration
   UVH: 4 – 6 weeks, one/week, HEP
   BVH: 4 – 12 weeks, one/week, HEP, forever active
5. Prediction of improvement depends on what outcome you consider