

Vestibular Rehabilitation Principles and Foundations

Amy Downing, PT
Vestibular Specialist
Owner of Element Physical Therapy
Missoula, MT

What is Vestibular Rehabilitation? AND Who would benefit from treatment?

- **Vestibular** rehabilitation is an exercise-based program, designed by a specialized physical therapist, to improve balance and reduce dizziness-related problems. The inner ear. The brains' 'balance center.'. At your appointment, a physical therapist will evaluate your symptoms and review your medical history. (Source: Cleveland Clinic website)
- **Vestibular rehabilitation is symptom driven.**

Audiology Testing

- Hearing test, VNG, Rotary Chair, oVEMP, cVEMP, ENG, Dix Hall Pike, SOT, Posturography, etc...

These tests may give you normal/abnormal results, however, what do you do with the test results other than report them to the doctor?

You know how to interpret the test results, but what does this mean for the patient?

Who would benefit from Vestibular Rehabilitation?

- In the Chronic dizzy patient and imbalanced patient why are symptoms continuing?
- Why has the natural compensation process not worked in some people?
- Have you ever wondered how to help these people without surgery or use of medication? Or perhaps the patient needs surgery and medications... How do you know which group of patients need what?

Let's first identify 2 groups of people

Group 1

- The patient has an UNSTABLE lesion, i.e., the locus of the lesion is changing over time.
- The historical hallmark is spontaneous events
- More likely to be assisted with medicine or surgery

Group 2

- The patient has a STABLE lesion yet uncompensated by the central process
- The historical hallmark is symptoms provoked by something
- More likely to be served with Vestibular Rehab Therapy (VBRT)

Slide Credit given to Neil Shepard, PhD.
Vestibular Rehabilitation Therapy for the Dizzy Patient

Vestibular and Balance Evaluation

Subjective History:

- Onset
- Description of symptoms
- Hearing Loss/Tinnitus/Pressure
- Visual Changes
- Difficulty reading- Do words jump? Are lines wavy? Do you need to use your finger to keep track of which line you are on when reading a newspaper?
- Migraines/headaches
- History of Falls or near falls? (Medicare defines a fall as an uncontrolled sit into a chair)
- Dizziness/vertigo
- Lightheadedness
- Imbalance
- Symptom provocation
- Fatigue level
- Confusion/orientation status
- Memory loss?
- Stairs into home or inside home?
- Do you live alone?
- Do you drive a car?
- Can you grocery shop?

Differential Diagnoses that can cause Dizziness

- Neuritis
- Labrynthitis
- Migraines and in particular Vestibular Migraines. -Must be medically managed first.
- Meniere's Disease / Endolymphatic Hydrops
- Perilymphatic fistulas
- Superior Canal dehiscence
- Concussions
- Labyrinth Concussions
- BPPV
- Cervicogenic Dizziness

Differential Diagnoses that can cause Dizziness

- Unilateral vestibular loss (UVL)
- Bilateral vestibular loss (BVL)
- Drug ototoxicity
- Highly unlikely to get true vertigo from lesion above the level of the pons- more likely to get imbalance, lightheadedness.
- Highly unlikely to get true vertigo from lesion in the area of the anterior circulation-carotid arteries-imbalance, lightheadedness.
- Vascular event- AICA/PICA-could be a mix of central ocular and peripheral hypofunction with postural control abnormalities.
- Conversion Disorders (Psychiatric disorders)

Subjective Complaints

- Most of us can experience a delusion of movement at some point in our life such as when we pull up next to a stopped bus at a stop light. Both our vehicles are stopped, the bus next to us starts rolling forward. We think we are moving so we press the brake even harder even though we aren't moving.
- Dizziness can be exacerbated by a moving train going by, light passing through trees when you are driving or a passenger in a car, bending over or looking upward, turning your head quickly to one side after someone calls your name, looking at a computer screen for too long, following a moving target or object, watching a live sporting event, being in a crowd, going grocery shopping, loud noises, etc...



OBJECTIVE EXAM

- Combination of direct exam and lab testing if available
- Vitals
- Orthostatic testing if indicated in light and in the dark

(New research tells us there can be a drop in blood pressure due to the vestibular system, not cardiovascular system, that occurs in the dark.)

- Coordination testing UE/LE

- Neurologic screening-Upper and lower motor neuron coordination testing; sensation and reflex testing. We use disposable monofilament kit on everyone to test for neuropathy
- We will begin using vibration testing on the bottom of feet coming soon. (On order)
- Vision/Oculomotor control screening
- Use of Oculography goggles in room light and with fixation removed. (Test for neuritis, labyrinthitis, central vs. peripheral signs)
- HINTS Exam (Head Impulse Nystagmus Test of Skew)
- Cover/uncover test
- Cover/Cross Cover test
- VOR cancellation
- Vestibular status and Vestibulo-ocular reflex testing
- Musculoskeletal
- Cognitive status
- BPPV all canals

VESTIBULAR/OCULAR-MOTOR SCREENING (VOMS) FOR CONCUSSION

Test: _____ DOB: ____/____/____ Male Female Date of Screen: ____/____/____

Name: _____

Symptom Driven

Vestibular/Ocular Motor Test	Not Tested	Headache 0-10	Dizziness 0-10	Nausea 0-10	Fatigue 0-10	Comments
BASELINE SYMPTOMS	N/A					
Smooth Pursuit						
Saccades-Horizontal						
Saccades-Vertical						
Convergence (Near Point)						(Near Point in cm) Measure 1: _____ Measure 2: _____ Measure 3: _____
VOR-Horizontal						
VOR-Vertical						
Visual Motion Sensitivity Test						

Objective Exam-System Integration Testing

- Direct Exam
- Test the three systems in our body responsible for balance:
 1. Somatosensation
 2. Vision
 3. Vestibular
- Use of Sensory Organization Test (SOT) of Dynamic Posturography or office technique of Clinical Test of Sensory Interaction and Balance
- Motor Control Test (MCT) or reaction to unexpected perturbations clinical or machine

Objective Exam-System Integration

- Functional use of the VOR (Vestibulo-Ocular Reflex) through testing of Dynamic Visual Acuity and Gaze Stabilization. This can be computerized or done clinically.
- Functional Gait Assessment/ Dynamic Gait Index; Berg (Gait and Balance testing)
- Movement sensitivity via MSQ (16 fast movements coding intensity duration).
- *REMEMBER ASSESSMENTS SET BOUNDARIES CONDITIONS, NOT TREATMENTS.*

EVALUATION COMPLETED!

- We would complete an 8-10 page typed evaluation, give it to the physicians and they would not know what to do with it...
- We actually had physician offices calling our office asking us to not send over the SOT results because they did not know how to interpret them, even though we had written the impairments on the report for them.
- Many physicians do not know what we do or even how we do it (yet alone what it means) , but they do know their patient do get better.
- So what is it that we do?

Vestibular Rehabilitation Therapy (VRT)

1. Gaze Stabilization Exercises
2. Balance/Gait training Exercises
3. Habituation Exercises
4. Dizziness/BPPV Treatment/Adaptation Exercises

Gaze Stabilization Test (GST) Dynamic Visual Acuity (DVA)

• Gaze Stabilization Test

The gaze stabilization test (GST) is a computerized test of the Vestibulo-ocular reflex that reports maximum head velocity while maintaining fixed **visual acuity**.

In other words it tests to see how fast a person can move their head and still see something accurately without having a retinal slip. The person must focus on an image such as an "E" and perform an ACTIVE head movement horizontally, vertically or diagonally. It is a functional, quantitative test of performance.

This test is **very** effective for concussion patients with return to play.

Dynamic Visual Acuity

Provides an instrumented, objective, behavioral assessment of Vestibulo-ocular reflex (VOR) function in response to rotational or functional head movement stimuli. The **Dynamic Visual Acuity Test (DVAT)** assesses **visual acuity** during head movement relative to baseline static **visual acuity**.

- It gives us a physiologic determination if someone has a unilateral or bilateral hypofunction.
- Reliable and valid-shown to reflect changes in patient performance that correlates to their subjective and objective improvements.
- Leads to Gaze stabilization Exercises.

GAZE STABILIZATION



Necessary Head Speeds for Activities

- Walk – 30 degrees/second
- Run- 60 degrees/second
- Drive a car-85 degrees/second
- Play Sports-120 degrees/second

Normal is 75 degrees/sec-120 degrees/sec

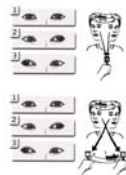
Vestibular Ocular Reflex (VOR) Exercise x 1

- The primary role of the inner ear and vestibular system is to allow you to keep your eyes stable and focused on objects as you move your head around. The goal of these exercises is to enhance the communication between your inner ears and your eyes.
- The brain uses the inner ear information to determine how much eye movement is needed to allow your eye to stay fixed on an object as you move around. If you move fast enough that the brain perceives difficulty staying fixed and focused, the brain may increase the signal from the inner ear to adjust.
- Over time you will be able to move faster and still maintain visual stability. When you finish an exercise session, you should feel a little uneasy. That means you have pushed the system sufficiently to trigger progress. If you feel perfectly fine, you are probably moving too slow. If you feel very nauseous, you are probably moving too fast. The image must be kept in FOCUS. If not STOP.

VOR Times 1 and Times 2

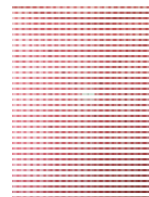
- The concept is to promote retinal slip in order to improve the use of the VOR for stabilization of a visual target with the head in motion. The patient can be sitting or standing. Typically, they start between 30 and 60 seconds moving the head as fast as they can as they keep the viewing object in FOCUS.
- In the VOR x 2 the eyes now move twice as far as they did in x 1 for the same head movement. Again start with 30-60 seconds.
- Start in sitting and progress to standing position. Start with feet shoulder width apart, then feet closer together with eventually feet in tandem if able. Start with a plain background, progressing to full field stimulus such as checkerboard table cloth or pictures in the background.

Gaze Stabilization Exercises



• VOR x 1

• VOR x 2



VOR EXERCISES

VOR X 1

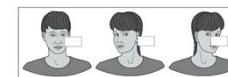
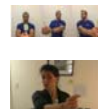


Figure 2A: Look straight ahead. Figure 2B: Tilt your head 45 degrees to the left. Figure 2C: Tilt your head 45 degrees to the right. Note: Glasses can be positioned at eye level. © T. J. Mullen, 2010

VOR X 2



VBRT

- For those with no defense for VOR exercises (gaze stabilization) do not give it--- a VOR deficit by Caloric, Rotary chair, vHIT is NOT a defense for the VOR exercises-it must be a functional deficit in the VOR via DVA/GST or visual analog scale.



FROM SPORTS TO GERIATRICS

- Natus® tested NFL players (Packers) GST scores: they naturally scored well into 275 degrees/second to 300 degrees/second horizontal head speed bilaterally.
- PT. clinic in CA teaches kids to become baseball players using GST/DVA software-they go on to get scholarships to colleges and universities.
- So...we tried it! We took the Mauler's worst hockey "scorer" and turned him into the second highest scorer for the season in (6)- 45 min treatments using GST software. He now has a full scholarship to college and plays hockey whereas before he couldn't afford to go to school.

Balance and Gait Tests

Dynamic Gait Index (DGI)

- 8 subtests that is effective for testing vestibular and non-vestibular patients.
- Each subtest has a potential for 3 points for a total maximal score of 24 points.
- Any score below 19 points indicates the patient is at a significant risk for falls.
- Reliable and valid.

Functional Gait Assessment (FGA) (Wrisley et al, 2004)

- 10 subtests that have a potential for 3 point scoring scale for each item for a total of 30 points.
- It is designed to incorporate those who are not identified in the DGI due to be higher level functioning, yet still has some impairment.

Balance and Gait Assessments-System Integration

- Timed Up and Go Test (TUG)/Modified TUG (Physical and Mental) Significant risk for falls for times >10 sec
- Gait Speed- there is age normative data 20-80. Have them walk and talk (Simple and Complex).
- Berg Balance Scale
- ABC- Activity Based Confidence Scale. There is a direct correlation with DGI improvement and ABC improvement once vestibular function has improved in these patients.
- Romberg/Tandem Romberg
- Tinetti falls risk scales and Falls Efficacy Scale for "fear of falls"
- BESS- Good for use with concussion balance testing
- Sudden Pull Backward (Wolfson et al, 1986)
- Functional Reach Scale
 - 4x increase risk of falls if < 15.4 cm (≤ 6 inches)
 - 8x increase risk of falls if unable to reach
 - Has detailed age normative ranges from 5 - 87

PHYSICAL THERAPY We see the balance experts

Balance Principles

- 1) Your weight should be equal on both feet
- 2) The weight should be slightly more forward on the ball of the foot than on the heel (5% forefoot to 45% heel).
- 3) The knees should be unlocked. They do not have to be bent but they should be relaxed. This will allow you to relax the buttocks, back, shoulders, and arms to allow the feet to control your balance and eliminate swaying of the body. This will also save a lot of energy and reduce fatigue.
- 4) Less swaying means the eyes and ears have less information to process which should help reduce the amount of dizziness or unsteadiness you feel during standing and walking.
- 5) In single leg stance the weight should be 60-70% on the forefoot for optimum control.
- 6) During walking if you push forward with the forefoot and toes each step you can take advantage of the same balance control you use during standing. The heel will land on touch first but the weight should move quickly onto the forefoot because of the push forward from the foot in back.

SOT



BESS



Motion Sensitivity Quotient (MSQ)

“Visual vertigo is defined as dizziness provoked by full field repetitive or moving visual environments of visual patterns.¹ There are several theories regarding the origin of visual vertigo/motion sensitivity; one theory is motion sensitivity and visual vertigo are due to a sensory conflict or mismatch between the visual, vestibular and somatosensory systems.^{2,3} It is thought that there is a possible discrepancy between what the person expected and the external stimuli received. Another theory is that the combination of a vestibular disorder and subsequent visual dependence is what causes visual vertigo.¹”

MSQ

“There are also several diagnoses which may contribute to visual vertigo/ motion sensitivity: migraine related vertigo, traumatic head injury, post-concussive syndrome, and cervicogenic dizziness/ whiplash associated dizziness.² Psychological disorders, including panic attacks, are also important differential diagnoses.¹”

References: 1. Bronstein AM. Vision and Vertigo: Some visual aspects of vestibular disorders. J Neurol. 2004;251:381-387. 2. Herdman SJ. Vestibular Rehabilitation. 3rd Ed. Philadelphia: FA Davis Company; 2007. 3. Sawle G. Visual vertigo. The Lancet. 1996;347:986-987.

MSQ

- **PURPOSE:** Clinical test designed to measure motion-provoked dizziness during a series of 16 quick changes to head or body positions. May also be used as a guide for developing an exercise program for patients with motion provoked dizziness
 - **TOOLS NEEDED:** Score Sheet, Stop watch, pencil, couch/table
 - **TIME TO ADMINISTER TEST:** 20-30 min
 - **AGE RANGE:** Adult: 18-64 years; Elderly adult: 65+
 - **POPULATIONS TESTED:** Community dwelling individuals with complaints of motion provoked dizziness during routine movements associated with daily living, Geriatrics, Traumatic Brain Injury, Vestibular Disorders.
- LEADS TO THE USE OF HABITUATION EXERCISES.

POSITION	INTENSITY	DURATION	SCORE
1. Sitting to Supine			
2. Supine feet left			
3. Feet Right			
4. Supine to Sit			
5. Left Side Head/Neck Down			
6. Return to sitting			
7. Right Side Head/Neck Down			
8. Return to sitting			
9. Seated Head to Left/Right			
10. Return to standing			
11. Standing Head to Left/Right			
12. Return to Standing			
13. Standing Head Forward			
14. Standing Head Back			
15. Standing Head Down			
16. Standing Head Down			
Motion Sensitivity	0 (no sig.) 2 (severe)	5-10 sec=1 11-30=-2	
Score = Intensity x duration			
Score = Intensity x duration			
TOTAL:			

Severe: ____ None: ____ Trace (1-3%) ____ Mild (4-16%) ____ Moderate (17-30%) ____ Severe (>31%)

MSQ DESCRIPTION

- Each subject performs 16 different head and/or body movements and instructed to indicate the onset and offset of any dizziness that occurred in each position.
- The duration of dizziness, which was recorded with a stopwatch, is assigned the following values: 1 point for 5s to 10s of dizziness, 2 points for 11s to 30s of dizziness, and 3 points for >30s of dizziness
- Subject is also asked to rate the intensity of the dizziness on a scale of 0 to 5 (0 = no symptoms, 5 = severe dizziness).
- A raw score for each position is calculated by adding duration score to the intensity score.
- MST quotient equals number of positions that provoked symptoms times the intensity and duration total for all positions divided by 2,048. Multiple by 100 for %.
- MST quotient of 0 indicates no symptoms; MST quotient of 100 indicates severe unremitting symptoms in all positions.
- Improvement is indicated by:
 - Decreased number of provoking positions
 - Increased number of reps before symptom occurrence
 - Decreased intensity of symptoms
 - Shorter duration of symptoms

Source: Rehab Measures Data Base

