

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 brain's '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
- Labyrinthitis
- 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 morifoliant 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

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

Symptom Driven

Vestibular/Ocular Motor Test	Not Tested	Headache	Dizziness	Nausea	Agitation	Comments
BASILINE SYMPTOMS	Y/N	D-10	D-10	D-10	D-10	
Smooth Pursuit						
Saccades-Horizontal						
Saccades-Vertical						
Convergence (Near Point)						Clear 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

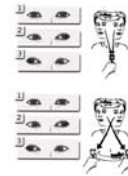
Vestibular Ocular Reflex (VOR) Exercise x 1

- 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

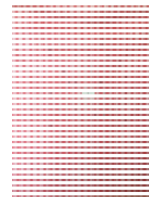
- The concept is to promote retinal slip in order to improve the use of the VOR for stabilization of a visual target with the head in motion. The patient can be sitting or standing. Typically, they start between 30 and 60 seconds moving the head as fast as they can as they keep the viewing object in 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

VOR X 2

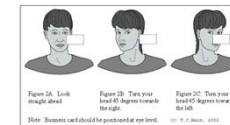
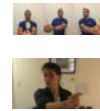


Figure 18. Look straight ahead. Figure 19. Turn your head to the right. Figure 20. Turn your head to the left. Note: Exercises will should be performed at eye level. © T. C. Moore, 2012



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
- Tinnette 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 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 (50% 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 any aching 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 or 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 in Spline			
2. Supine Roll Left			
3. Roll Right			
4. Supine to Sit			
5. Left Side to Supine			
6. Return to Spline			
7. Prone			
8. Return to Spline			
9. Stand on Spline			
10. Return to Spline			
11. Stand on Spline			
12. Stand on Spline			
13. Stand on Spline			
14. Stand on Spline			
15. Stand on Spline			
16. Stand on Spline			
17. Stand on Spline			
18. Stand on Spline			
19. Stand on Spline			
20. Stand on Spline			
21. Stand on Spline			
22. Stand on Spline			
23. Stand on Spline			
24. Stand on Spline			
25. Stand on Spline			
26. Stand on Spline			
27. Stand on Spline			
28. Stand on Spline			
29. Stand on Spline			
30. Stand on Spline			
31. Stand on Spline			
32. Stand on Spline			
33. Stand on Spline			
34. Stand on Spline			
35. Stand on Spline			
36. Stand on Spline			
37. Stand on Spline			
38. Stand on Spline			
39. Stand on Spline			
40. Stand on Spline			
41. Stand on Spline			
42. Stand on Spline			
43. Stand on Spline			
44. Stand on Spline			
45. Stand on Spline			
46. Stand on Spline			
47. Stand on Spline			
48. Stand on Spline			
49. Stand on Spline			
50. Stand on Spline			
51. Stand on Spline			
52. Stand on Spline			
53. Stand on Spline			
54. Stand on Spline			
55. Stand on Spline			
56. Stand on Spline			
57. Stand on Spline			
58. Stand on Spline			
59. Stand on Spline			
60. Stand on Spline			
61. Stand on Spline			
62. Stand on Spline			
63. Stand on Spline			
64. Stand on Spline			
65. Stand on Spline			
66. Stand on Spline			
67. Stand on Spline			
68. Stand on Spline			
69. Stand on Spline			
70. Stand on Spline			
71. Stand on Spline			
72. Stand on Spline			
73. Stand on Spline			
74. Stand on Spline			
75. Stand on Spline			
76. Stand on Spline			
77. Stand on Spline			
78. Stand on Spline			
79. Stand on Spline			
80. Stand on Spline			
81. Stand on Spline			
82. Stand on Spline			
83. Stand on Spline			
84. Stand on Spline			
85. Stand on Spline			
86. Stand on Spline			
87. Stand on Spline			
88. Stand on Spline			
89. Stand on Spline			
90. Stand on Spline			
91. Stand on Spline			
92. Stand on Spline			
93. Stand on Spline			
94. Stand on Spline			
95. Stand on Spline			
96. Stand on Spline			
97. Stand on Spline			
98. Stand on Spline			
99. Stand on Spline			
100. Stand on Spline			
101. Stand on Spline			
102. Stand on Spline			
103. Stand on Spline			
104. Stand on Spline			
105. Stand on Spline			
106. Stand on Spline			
107. Stand on Spline			
108. Stand on Spline			
109. Stand on Spline			
110. Stand on Spline			
111. Stand on Spline			
112. Stand on Spline			
113. Stand on Spline			
114. Stand on Spline			
115. Stand on Spline			
116. Stand on Spline			
117. Stand on Spline			
118. Stand on Spline			
119. Stand on Spline			
120. Stand on Spline			
121. Stand on Spline			
122. Stand on Spline			
123. Stand on Spline			
124. Stand on Spline			
125. Stand on Spline			
126. Stand on Spline			
127. Stand on Spline			
128. Stand on Spline			
129. Stand on Spline			
130. Stand on Spline			
131. Stand on Spline			
132. Stand on Spline			
133. Stand on Spline			
134. Stand on Spline			
135. Stand on Spline			
136. Stand on Spline			
137. Stand on Spline			
138. Stand on Spline			
139. Stand on Spline			
140. Stand on Spline			
141. Stand on Spline			
142. Stand on Spline			
143. Stand on Spline			
144. Stand on Spline			
145. Stand on Spline			
146. Stand on Spline			
147. Stand on Spline			
148. Stand on Spline			
149. Stand on Spline			
150. Stand on Spline			
151. Stand on Spline			
152. Stand on Spline			
153. Stand on Spline			
154. Stand on Spline			
155. Stand on Spline			
156. Stand on Spline			
157. Stand on Spline			
158. Stand on Spline			
159. Stand on Spline			
160. Stand on Spline			
161. Stand on Spline			
162. Stand on Spline			
163. Stand on Spline			
164. Stand on Spline			
165. Stand on Spline			
166. Stand on Spline			
167. Stand on Spline			
168. Stand on Spline			
169. Stand on Spline			
170. Stand on Spline			
171. Stand on Spline			
172. Stand on Spline			
173. Stand on Spline			
174. Stand on Spline			
175. Stand on Spline			
176. Stand on Spline			
177. Stand on Spline			
178. Stand on Spline			
179. Stand on Spline			
180. Stand on Spline			
181. Stand on Spline			
182. Stand on Spline			
183. Stand on Spline			
184. Stand on Spline			
185. Stand on Spline			
186. Stand on Spline			
187. Stand on Spline			
188. Stand on Spline			
189. Stand on Spline			
190. Stand on Spline			
191. Stand on Spline			
192. Stand on Spline			
193. Stand on Spline			
194. Stand on Spline			
195. Stand on Spline			
196. Stand on Spline			
197. Stand on Spline			
198. Stand on Spline			
199. Stand on Spline			
200. Stand on Spline			
201. Stand on Spline			
202. Stand on Spline			
203. Stand on Spline			
204. Stand on Spline			
205. Stand on Spline			
206. Stand on Spline			
207. Stand on Spline			
208. Stand on Spline			
209. Stand on Spline			
210. Stand on Spline			
211. Stand on Spline			
212. Stand on Spline			
213. Stand on Spline			
214. Stand on Spline			
215. Stand on Spline			
216. Stand on Spline			
217. Stand on Spline			
218. Stand on Spline			
219. Stand on Spline			
220. Stand on Spline			
221. Stand on Spline			
222. Stand on Spline			
223. Stand on Spline			
224. Stand on Spline			
225. Stand on Spline			
226. Stand on Spline			
227. Stand on Spline			
228. Stand on Spline			
229. Stand on Spline			
230. Stand on Spline			
231. Stand on Spline			
232. Stand on Spline			
233. Stand on Spline			
234. Stand on Spline			
235. Stand on Spline			
236. Stand on Spline			
237. Stand on Spline			
238. Stand on Spline			
239. Stand on Spline			
240. Stand on Spline			
241. Stand on Spline			
242. Stand on Spline			
243. Stand on Spline			
244. Stand on Spline			
245. Stand on Spline			
246. Stand on Spline			
247. Stand on Spline			
248. Stand on Spline			
249. Stand on Spline			
250. Stand on Spline			
251. Stand on Spline			
252. Stand on Spline			
253. Stand on Spline			
254. Stand on Spline			
255. Stand on Spline			
256. Stand on Spline			
257. Stand on Spline			
258. Stand on Spline			
259. Stand on Spline			
260. Stand on Spline			
261. Stand on Spline			
262. Stand on Spline			
263. Stand on Spline			
264. Stand on Spline			
265. Stand on Spline			
266. Stand on Spline			
267. Stand on Spline			
268. Stand on Spline			
269. Stand on Spline			
270. Stand on Spline			
271. Stand on Spline			
272. Stand on Spline			
273. Stand on Spline			
274. Stand on Spline			
275. Stand on Spline			
276. Stand on Spline			
277. Stand on Spline			
278. Stand on Spline			
279. Stand on Spline			
280. Stand on Spline			
281. Stand on Spline			
282. Stand on Spline			
283. Stand on Spline			
284. Stand on Spline			
285. Stand on Spline			

