Outpatient Vestibular Rehabilitation For A Patient Three Months Post Acoustic Neuroma Resection: A Case Report

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Outpatient Vestibular Rehabilitation for a Patient Three Months Post Acoustic Neuroma Resection: A Case Report

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The author acknowledges Amy Litterini, PT, DPT, for assistance with the development of this case report, Melissa Lanoie, DPT, for assistance with the development of the plan of care, and the patient for his willingness to participate.

The patient signed an informed consent allowing the use of medical information for this report. The patient also received information on the institution’s policies regarding the Health Insurance Portability and Accountability Act.
ABSTRACT

Background and purpose: An acoustic neuroma is a benign and slow growing intracranial tumor that affects the vestibular nerve. The tumor and subsequent surgery frequently lead to vestibular dysfunction resulting in dizziness, postural instability, and oscillopsia, leading to increased fall risk and a reduction in quality of life. The purpose of this case report is to describe the outpatient physical therapy (PT) management of a patient with chronic symptoms of vestibular dysfunction three months post-surgical removal of an acoustic neuroma.

Case Description: The patient was a 51 year-old male who first began experiencing severe headaches eight months prior to his initial examination. An acoustic neuroma was identified and surgically removed five months following diagnosis. PT services focused on evaluating and treating his impaired gazed stabilization and postural control.

Outcomes: After four weeks of treatment on re-evaluation, the patient demonstrated minimal improvements in vestibulo-ocular reflex (VOR) function and postural control. Reported symptoms of dizziness, unsteadiness, and oscillopsia also improved minimally, although continued to be limiting with ADLs and return to work. Final outcomes were unable to be assessed at the prescribed end of the plan of care due to physician recommended leave from PT services secondary to increased headache severity.

Discussion: Minimal improvements in VOR function may support the use of vestibular rehabilitation for this patient with chronic symptoms of unilateral vestibular hypofunction (UVH) three months post resection surgery. This study may suggest the importance of symptom management and inter-professional communication as the physician’s recommended leave from PT may have limited final patient outcomes. Future research may focus on expected outcomes for patients with chronic UVH with delayed vestibular rehabilitation following resection surgery.

Abstract Word Count: 272
BACKGROUND and PURPOSE

An acoustic neuroma, also known as a vestibular schwannoma, is a benign and slow growing primary intracranial tumor that originates from Schwann cells of the vestibular nerve within the inner ear. It is estimated that acoustic neuromas occur in 10-20 individuals per 1,000,000 annually in the United States.¹ The tumor itself is often treated through surgical removal; however, the tumor and subsequent surgery frequently lead to vestibular nerve impairment.²

The vestibular nerve transmits sensory information to the brain from the peripheral vestibular system of the inner ear. Damage to one of the vestibular nerves may lead to vestibular dysfunction on the ipsilateral side, known as unilateral vestibular hypofunction (UVH). The peripheral vestibular system coordinates head and eye movement in order to maintain visual focus through the vestibulo-ocular reflex (VOR), helps maintain postural stability, and provides information used for spatial orientation.² Impaired vestibular function may thus result in complaints of dizziness, postural instability, and oscillopsia, or visual blurring with head movement.

Appropriate treatment of vestibular dysfunction is important, as dizziness is a major risk factor for falls. The incidence of falls is higher in individuals with vestibular dysfunction than in age-matched healthy individuals.³ Additionally, patients who experience dizziness report a reduction in their quality of life.⁴ Ideally, vestibular rehabilitation through physical therapy (PT) is initiated immediately following recognition of vestibular dysfunction in order to help resolve symptoms.

There are a variety of evaluation procedures utilized in vestibular rehabilitation in order to assess a patient’s level of vestibular dysfunction. Common outcome measures are used to
assess one’s level of VOR impairment through visual acuity and gaze stability tests, such as the Dynamic Visual Acuity test (DVAT) or the Rapid Head Thrust test (HTT). Nystagmus, defined as rapid and involuntary eye movements, may be observed during VOR assessment and is a primary indicator used in identifying vestibular lesions. With a unilateral vestibular lesion, nystagmus occurs with both slow and fast component eye movements, while the slow component is indicative of the direction of the lesion. Other outcome measures may also assess postural stability with static standing and dynamic gait tests through altering conditions for sensory input, such as with the Modified Clinical Test of Sensory Interaction on Balance (mCTSIB). Additionally, it is important to assess a patient’s perception of their level of disability, such as through the Dizziness Handicap Inventory (DHI).

Treatment for vestibular dysfunction is based on the principles of VOR adaptation, postural stability, and habituation. While there is moderate to strong evidence supporting vestibular rehabilitation in the management of patients with vestibular dysfunction, including UVH, it is important that treatment be individualized to target the patient’s specific impairments. Vestibular rehabilitation is well supported by literature for patients with acute UVH immediately following surgical removal of an acoustic neuroma. Additionally, there is strong evidence supporting the use of vestibular rehabilitation for patients with chronic symptoms of UVH in general lasting greater than two months. However, there is little evidence supporting the use of vestibular rehabilitation for patients with chronic symptoms of UVH, specifically post-surgical removal of an acoustic neuroma. Therefore, the purpose of this case report is to describe the outpatient PT management of a patient with chronic symptoms of UVH three months after surgical removal of an acoustic neuroma.

CASE DESCRIPTION

Patient History and Systems Review
The patient provided written consent to participate in this case report. He was a 51 year-old male who resided locally with his wife and two children when he first began experiencing severe headaches eight months prior to his initial examination (IE). Upon visiting his primary care physician (PCP), magnetic resonance imaging (MRI) was conducted which revealed a right-sided acoustic neuroma. A shunt was placed three months later followed by surgical removal of the tumor two months after the placement of his shunt. He did not receive PT immediately following his surgery and had periodic visits with his PCP. He was referred to outpatient PT services three months following surgery in order to treat his reported symptoms of dizziness and headaches. He had no significant past medical history to affect treatment. He also had no complaints regarding his musculoskeletal system and had only minimal cardiovascular deconditioning from a reduction in activity within the year due to his onset of symptoms. The patient was not receiving any other treatment. For a full outcome of the patient’s systems review, refer to Table 1.

Upon his initial visit to PT, his chief complaints included dizziness, headaches, and oscillopsia leading to feelings of mild unsteadiness while on his feet. Since his surgery three months prior, he reported multiple occasions of room spinning vertigo with certain bending or turning movements and his symptoms typically increased in frequency later in the day. The patient further presented with complete hearing loss in his right ear with occasional numbness and tingling on the right side of his face and tongue. His self-reported goals through PT were to be rid of his blurred vision when attempting to focus his gaze, to be free of his dizziness, and to be able to get around throughout the day without difficulty.

Clinical Impression 1

The patient’s primary impairments included oscillopsia, dizziness, headaches, and reported feelings of unsteadiness while on his feet consistent with symptoms of UVH. His
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Impairments limited his ability to work and led to an increased fall risk. Benign paroxysmal positional vertigo (BPPV) was questioned as a differential diagnosis due to his general symptoms but was not strongly considered due to his known surgical insult correlating with UVH.

The plan for his initial examination would include an assessment of his VOR function and postural control. A Dix-Hallpike would be performed to rule out BPPV. The Dynamic Gait Index test (DGI), commonly utilized for UVH, would not be administered due to a ceiling effect as his gait appeared very stable and he reported not commonly experiencing symptoms of dizziness unless attempting to maintain visual focus while in the community. A DHI (see Appendix 1) would be administered to address his level of perceived handicap. This patient remained a good candidate for this case report due to his level of symptoms consistent with vestibular dysfunction and the rarity of his diagnosis.

**Examination – Tests and Measures**

The results of the initial examination can be viewed in Table 2. An oculomotor exam was first given to assess his gaze fixation and visual tracking. The patient was able to maintain gaze on a pen held at arm’s length distance and then to visually track the pen as it was moved by the therapist in horizontal, vertical, and diagonal planes (see Figure 1A, B) without symptoms of nystagmus. His VOR function was further assessed with the DVAT, HTT, and a VOR x 1 exercise involving horizontal and vertical head turns while maintaining gaze at a letter placed on an index card held at arm’s length distance (see Figure 1C, D). He reported visual blurring during the VOR x 1 exercise at slow and fast speeds, demonstrating impaired gaze stability, which indicated VOR dysfunction. The DVAT (see Appendix 2), as described by Dannenbaum et al, more objectively measures an individual’s VOR function. It has a high sensitivity rate of 100% and a high specificity of 94% for individuals with UVH when compared to individuals.
with unimpaired vestibular function.\textsuperscript{12} The patient’s DVAT revealed a six line disparity, further indicating impaired VOR function. A HTT (see Appendix 4), as described by Schubert et al.,\textsuperscript{13} was additionally utilized to diagnose VOR impairment as it can help to confirm the side of dysfunction. This test has strong predictive validity for vestibular dysfunction as it has an excellent specificity of 100\% for patients with an acoustic neuroma.\textsuperscript{14} During the HTT, the patient was unable to maintain visual focus to the right confirming a right-sided VOR impairment.

His static standing balance was tested with the mCTSIB, as designed by Shumway-Cook and Horak,\textsuperscript{15} which involves standing in four separate conditions (see Figure 2). The varied conditions limit visual and somatosensory input in order to assess vestibular function on static standing balance. The patient was able to maintain standing in all conditions for >30 seconds with moderate postural sway, possibly indicating a well compensating left vestibular function. There is minimal literature supporting validity or reliability of the mCTSIB for patients with vestibular dysfunction, but the test was reasoned to be appropriate due to the test conditions isolating vestibular function on static standing balance. A Dix-Hallpike test, as described by Dix and Hallpike,\textsuperscript{15} was administered without goggles to assess for BPPV, which was negative bilaterally.\textsuperscript{16} He additionally scored a 44 on the DHI indicating moderate perceived handicap due to dizziness. The DHI has been found to have excellent test-retest reliability and an excellent correlation with the Activities-Specific Balance Confidence scale.\textsuperscript{17,18}

\textbf{Clinical Impression 2}

Following the initial examination, the initial impression was confirmed that the patient had a right-sided UVH due to findings of impaired VOR with the DVAT and the HTT that were consistent with his complaints of impaired gaze stabilization. He had no significant impairments noted with postural control, as tested by the mCTSIB, but he demonstrated moderate postural...
sway with reported feelings of unsteadiness throughout. These findings were consistent with common impairments of UVH along with his self-reported symptoms of dizziness since his diagnosis and surgical resection. The patient continued to be appropriate for the case due to his reported moderate perceived handicap on the DHI as well as impaired VOR, which limited his normal activities of daily living (ADLs).

His plan of care was initially scheduled for 30-45 minute appointments twice a week for eight weeks in combination with a daily home exercise program (HEP). His medical diagnosis, as referred by his PCP, was an acoustic neuroma resection with recurrent dizziness and his PT diagnosis was determined to be UVH. The prognosis for his plan of care was good due to literature supporting vestibular rehabilitation, and since therapeutic exercise to address gaze stability and postural control has been shown to decrease symptoms of dizziness thus helping aid return to a prior level of function. His prognosis was additionally supported by his general health status with an absence of any co-morbidities. There were no plans for referral at this time and he remained in contact with his PCP for periodic visits. No additional testing was recommended.

The focus of his interventions would be primarily aimed at enhancing his VOR function through exercises for gaze stability while challenging his postural control. It was determined that a focus on dynamic balance would be included due to his self-reported dizziness experienced when walking in the community, despite his relatively intact postural control demonstrated on the mCTSIB. Short and long term goals for PT can be referenced in Table 3.

**Interventions**

Interventions were coordinated by the primary PT and discussed with the patient. There was direct communication with the patient during treatment sessions for exercise related instruction, and the patient was given verbal directions along with a handout for exercises to
complete for his HEP. All exercises during the plan of care had potential for symptom provocation; therefore, patient/client-related instruction focused on symptom management was also directly communicated. The intensity for all exercises was set to achieve no more than one–two minutes of symptoms, including dizziness and headaches. All sessions were documented in an electronic medical record including details of each exercise and symptom response from the patient. He did not receive any co-interventions from other health care providers.

Initial treatment for gaze stabilization included VOR x 1 exercises (see Figure 1C and D). Head turns were performed at a speed allowing the patient to maintain visual focus of a letter placed on an index card for 2-3 sets and for up to 30 seconds each set. The purpose of the exercise was to adapt his right-sided VOR function by enhancing coordination of his head and eye movements. After two weeks of treatment, the patient was able to tolerate head turns at a slow speed only. Additional VOR exercises included utilizing two index cards with a letter on them placed side by side on a wall at arm’s length distance. The patient actively gazed at an adjacent card with only eye movement followed by active head movement oriented toward the card. The patient then coordinated looking left to right between the cards, each time looking with eyes only first followed by head movement second, completed at a speed allowing the patient to maintain focus of the letters on the cards. Both VOR exercises focused on improving VOR adaptation, which proved difficult for the patient, as he was able to maintain focus at slow speeds only while staying within the symptom management guideline.

VOR exercises were chosen based on sufficient evidence of use within vestibular rehabilitation. In a randomized, double-blind study by Herdman et al,21 21 patients with UVH were divided into two groups. One group (n=13) performed VOR exercises for up to 30 minutes per day for four weeks as the other group (n=8) performed placebo exercises for the same time parameters. At the end of the four weeks, the groups crossed-over and performed another four
weeks of exercises. Each group, when performing VOR exercises during their four-week interval, demonstrated improved scores on the DVAT compared to the placebo group indicating improved VOR adaptation from specific gaze stabilization exercises.

Initial postural control exercises included slow forward marches while holding a 10-pound ActivMotion Bar (ActivMotion Bar, Detroit, MI) internally weighted with dynamic steel-bearing marbles performed for 2 sets of 25 feet (see Figure 3A) as well as static standing on a Rocker Board (FitterFirst, Calgary, Alberta) for 2-3 sets for up to 30 seconds each set. After two weeks of treatment, additional exercises were included to further challenge his postural control by including simultaneous coordination of head and eye movements in order to further improve his VOR adaptation. These interventions included forward gait with horizontal and vertical head turns performed for 2 sets of 50 feet and forward gait with self-toss and catch with a 2# medicine ball (Ideal Products, Broseley, MO) for 2 sets of 50 feet (see Figure 3B). Also included was an exercise involving walking on a treadmill (Star Trac, model 4500, Vancouver, WA) at 1.3 mph with a white board placed in front of the treadmill (see Figure 3C). Twenty, inch-high letters were scattered on the white board and the patient was asked to identify and point to the letters as the therapist called them, all while maintaining his gait speed. Tandem walks with horizontal head turns for 2 sets of 25 feet were also integrated. In a randomized controlled trial by Vereeck et al, 15 patients following resection of an acoustic neuroma who completed 12 weeks of vestibular rehab, including narrow-based walking exercises with head turning, demonstrated improvements in the Timed Up and Go test and the DGI when compared to 11 patients following an acoustic neuroma resection who completed only generalized exercise training. This patient was able to demonstrate improved dynamic balance as well as report subjective improvements in steadiness following treatment focused on postural control. He required stand by assist (SBA) as
he experienced two to three losses of balance per session, which he recovered by utilizing a stepping strategy.

He completed a HEP daily for up to 10 minutes a day, including VOR x 1 exercises as performed in the clinic. He was not instructed to complete dynamic gait exercises at home due to safety, but was encouraged to begin walking to increase his level of activity. Compliance with his symptom management guideline at home was further reiterated to not over-provoke symptoms.

He reported dizziness and occasional headaches following initial exercises, but symptoms resolved within two minutes of rest. He demonstrated gradual improvements and good compliance over a four-week period, as he was able to increase his head speed with VOR exercises with less symptom provocation, as well as increasing the difficulty of dynamic balance exercises to include tandem gait with coordinated head movement. He cancelled two appointments, once during week two and once during week four, due to severe headaches not permitting him to drive. During his scheduled fifth week of treatment, he again had to cancel due to severe headaches limiting his participation. Eventually, he reported needing to take a temporary absence from PT due to the increase in his headache severity and frequency; his referring physician further recommended the temporary hold in order to allow symptoms to subside.

Final outcomes were not established for this patient due to his recommended hold from PT from his referring physician before the end of his prescribed plan of care. A re-evaluation was performed during his fourth week of treatment (see Table 2). The DVAT and HTT were again performed for VOR assessment. He demonstrated a five-line disparity with the DVAT
indicating a slight improvement, but continued VOR dysfunction. Similarly, the results of the HTT remained consistent with right-sided VOR dysfunction. Though, improvements of his performance with VOR x 1 exercises were observed as he was able to increase his head speed with less symptom provocation compared to his initial examination. Assessment of his postural control with the mCTSIB demonstrated decreased postural sway while he managed standing in all conditions for >30 seconds. Additionally, his DHI score revealed a 40 compared to a 44 on his IE, indicating slight improvement but still categorizing him as a moderate handicap due to perceived dizziness.

Overall, the patient demonstrated only minimal improvements for his outcomes measures during his four weeks of treatment focused on VOR adaptation and postural control. Although, he did report subjective improvements in his overall dizziness and steadiness experienced during the day with activity. He also described decreased oscillopsia during ADLs and while in the community. The patient’s reported symptoms, although improved, remained limiting with ADLs and his return to work, including the increase in his headache frequency and severity.

**DISCUSSION**

This case study was limited in demonstrating its intended purpose as the patient was unable to complete the full eight weeks of his plan of care due to his physician’s recommendation for a temporary hold from PT services secondary to an exacerbation of the patient’s headache frequency and severity. Only four weeks of treatment were completed and the patient missed two appointments during that time. The patient demonstrated motivation to complete his plan of care and was compliant with treatment when his headaches were not limiting; however, his physician recommended hold led to an incompletion of his plan of care and potentially prevented any significant improvements in his intended outcomes.

The minimal improvements made in his VOR adaptation, postural control, and reported
symptoms may indicate that the literature supporting vestibular rehabilitation is beneficial for this patient with chronic symptoms of UVH three months following an acoustic neuroma resection; however, greater than four weeks of treatment may be necessary for further improvements and a potential full recovery. This case study may suggest the clinical importance of direct communication between the therapist and referring physician as continued treatment for symptom management was recommended despite the physician’s recommended hold on PT services. The suspected etiology of the patient’s recent exacerbation of headaches, and next steps in management, were also unknown and not openly communicated between the therapist and physician. The unknown etiology of his increase in headache frequency and severity may additionally point to the importance of vestibular management immediately following acoustic neuroma resection as this patient demonstrated chronic symptoms that remained untreated following surgery three months prior to beginning PT services. His headache frequency and severity was his greatest limiting factor for participation in treatment.

Future research may focus on expected outcomes for patients with chronic UVH with delayed vestibular rehabilitation following acoustic neuroma resection, particularly when compared to patients who complete vestibular rehabilitation immediately following resection surgery.

REFERENCES

5. Hoffer ME, Balaban CD, Whitney SL, Sparto PJ. Principles of vestibular physical therapy


**TABLES and FIGURES**

**Table 1. Systems Review**

<table>
<thead>
<tr>
<th>Systems Review</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardiovascular/Pulmonary</strong></td>
<td>Unimpaired</td>
</tr>
<tr>
<td><strong>Musculoskeletal</strong></td>
<td>Unimpaired</td>
</tr>
<tr>
<td><strong>Neuromuscular</strong></td>
<td>Impaired – unilateral vestibular hypofunction from right acoustic neuroma, dizziness</td>
</tr>
<tr>
<td><strong>Integumentary</strong></td>
<td>Unimpaired</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>Impaired – complete hearing loss in right ear</td>
</tr>
<tr>
<td><strong>Affect, Cognition, Language, Learning Style</strong></td>
<td>Unimpaired – he reported being a visual learner</td>
</tr>
</tbody>
</table>

**Table 2. Tests & Measures**

<table>
<thead>
<tr>
<th>Tests &amp; Measures</th>
<th>Initial Evaluation Results</th>
<th>Re-evaluation Results (week 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaze fixation in all directions</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>Visual tracking in all directions</td>
<td>Smooth</td>
<td>Smooth</td>
</tr>
<tr>
<td>VOR x 1</td>
<td>Blurry at fast and slow speeds</td>
<td>Blurry at fast speeds only</td>
</tr>
<tr>
<td>Dynamic Visual Acuity test</td>
<td>6 line disparity</td>
<td>5 line disparity</td>
</tr>
<tr>
<td>mCTSIB</td>
<td>&gt;30s in all conditions</td>
<td>&gt;30s in all conditions</td>
</tr>
<tr>
<td>Dix-Hallpike</td>
<td>Negative B/L</td>
<td></td>
</tr>
<tr>
<td>Dizziness Handicap Inventory</td>
<td>44 indicating moderate handicap</td>
<td>40 indicating moderate handicap</td>
</tr>
</tbody>
</table>

VOR=vestibulo-ocular reflex, mCTSIB=modified clinical test of sensory interaction on balance, B/L=bilaterally
Figure 1. Assessment for gaze stability and vestibulo-ocular reflex (VOR) function
Assessment for gaze stability involved A. gaze fixation and visual tracking as pen moves within horizontal plane; B. gaze fixation and visual tracking as pen moves within diagonal plane; C. VOR assessment for gaze stability with ~45 degree head turns in the horizontal plane; D. VOR assessment for gaze stability with ~45 degree head turns in the vertical plane.

Figure 2. Modified Clinical Test of Sensory Interaction on Balance (mCTSIB) \(^{15}\)
The four tested conditions of the mCTSIB involved A. static standing on a firm surface with eyes open; B. static standing on a firm surface with eyes closed; C. static standing on a foam surface with eyes open; D. static standing on a foam surface with eyes closed.

Table 3. Goals
STG - 4 weeks  Patient will decrease DHI score to <36% for decreased perception of dizziness
STG - 4 weeks  Patient will be able to complete VOR x 1 exercises without complaints of dizziness
LTG - 8 weeks  Patient will demonstrate <2 line change on the DVAT for improved VOR function
LTG - 8 weeks  Patient will be able to ambulate within the community without reports of dizziness

STG=short term goal, DHI=dizziness handicap inventory, VOR=vestibulo-ocular reflex, LTG=long term goal, DVAT=dynamic visual acuity test

Figure 3. Interventions for dynamic postural control with coordinated gaze stability
Interventions for postural control involved A. slow forward marches while holding a 10-pound ActivMotion Bar with gaze fixation; B. forward gait with self-toss and catch with a 2-pound medicine ball; C. walking at 1.3mph while identifying letters on a white board as called by the therapist.

APPENDICES

Appendix 1. Dizziness Handicap Inventory
## Dizziness Handicap Inventory

**Instructions:** The purpose of this scale is to identify difficulties that you may be experiencing because of your dizziness. Please check “always”, or “no” or “sometimes” to each question. Answer each question only as it pertains to your dizziness problem.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Always</th>
<th>Sometimes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 Does looking up increase your problem?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E2 Because of your problem, do you feel frustrated?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F3 Because of your problem, do you resind your travel for business or pleasure?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P4 Does walking down the aisle of a supermarket increase your problem?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F5 Because of your problem, do you have difficulty getting into or out of bed?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F6 Does your problem significantly restrict your participation in social activities, such as going out to dinner, going to movies, dancing or to parties?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F7 Because of your problem, do you have difficulty reading?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F8 Does performing more ambitious activities like sports, dancing, and household chores, such as sweeping or putting dishes away, increase your problem?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E9 Because of your problem, are you afraid to leave your home without having someone accompany you?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E10 Because of your problem, have you been embarrassed in front of others?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P11 Do quick movements of your head increase your problem?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F12 Because of your problem, do you avoid heights?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P13 Does turning over in bed increase your problem?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F14 Because of your problem, is it difficult for you to do strenuous housework or yard work?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E15 Because of your problem, are you afraid people may think that you are intoxicated?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F16 Because of your problem, is it difficult for you to go for a walk by yourself?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P17 Does walking down a sidewalk increase your problem?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E18 Because of your problem, is it difficult for you to concentrate?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F19 Because of your problem, is it difficult for you to walk around your house in the dark?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E20 Because of your problem, are you afraid to stay home alone?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E21 Because of your problem, do you feel handicapped?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E22 Has your problem placed stress on your relationship with members of your family or friends?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E23 Because of your problem, are you depressed?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F24 Does your problem interfere with your job or household responsibilities?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P25 Does bending over increase your problem?</td>
<td></td>
<td></td>
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### Scoring for Dizziness Handicap Inventory

<table>
<thead>
<tr>
<th>Eval</th>
<th>Total Functional</th>
<th>Total Emotional</th>
<th>Total Physical</th>
<th>TOTAL SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reassess #1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reassess #2</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Reassess #3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reassess #4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Always = 4  
Sometimes = 2  
No = 0  
P = physical  
E = emotional  
F = functional  
Subscales

**Notes:**

1. Subjective measure of the patient’s perception of handicap due to the dizziness
2. Top score is 100 (maximum perceived disability)
3. Bottom score is 0 (no perceived disability)
4. The following 5 items can be useful in predicting BPPV
   - Does looking up increase your problem?
   - Because of your problem, do you have difficulty getting into or out of bed?
   - Do quick movements of your head increase your problem?
   - Does bending over increase your problem?
5. Can use subscale scores to track change as well
Appendix 2. Dynamic Visual Acuity Test (DVAT)\textsuperscript{10}

The patient first completes a standard visual acuity test 10 feet away from a Snellen chart (see Appendix 3) with their head in a static position. A DVAT is followed utilizing the same parameters as the static visual acuity test on the Snellen chart, but now an examiner passively moves the patient’s head left to right with 20 degree excursions at a velocity of 120 degrees per second.\textsuperscript{11} The test is scored by the difference in the number of lines the individual can read on the chart with the DVAT compared to the static version. Normal scores include a $\leq$ two-line difference.

Appendix 3. Snellen Chart\textsuperscript{22}
Appendix 4. Rapid Head Thrust Test (HTT)\textsuperscript{13}
A HTT is performed by asking the patient to maintain gaze at a target as the examiner grasps the patient above the ears and positions the patient in 30 degrees of cervical flexion. The examiner passively rotates the patient’s head back and forth slowly in the horizontal plane and then provides rapid rotation 10 degrees from midline while assessing whether the patient can maintain visual focus on the target. Individuals with impaired vestibulo-ocular reflex function will demonstrate a corrective saccade after the head is thrust toward the side of their dysfunction.