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# Retrospective review and telephone follow-up to evaluate a physical therapy protocol for treating persistent postural-perceptual dizziness: A pilot study

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**Abstract.**
**BACKGROUND:** Persistent postural-perceptual dizziness (PPPD) (formerly chronic subjective dizziness) may be treated using the habituation form of vestibular and balance rehabilitation therapy (VBRT), but therapeutic outcomes have not been formally investigated.
**OBJECTIVE:** This pilot study gathered the first data on the efficacy of VBRT for individuals with well-characterized PPPD alone or PPPD plus neurotologic comorbidities (vestibular migraine or compensated vestibular deficits).
**METHODS:** Twenty-six participants were surveyed by telephone an average of 27.5 months after receiving education about PPPD and instructions for home-based VBRT programs. Participants were queried about exercise compliance, perceived benefits of therapy, degree of visual or motion sensitivity remaining, disability level, and other interventions.
**RESULTS:** Twenty-two of 26 participants found physical therapy consultation helpful. Fourteen found VBRT exercises beneficial, including 8 of 12 who had PPPD alone and 6 of 14 who had PPPD with co-morbidities. Of the 14 participants who found VBRT helpful, 7 obtained relief of sensitivity to head/body motion, 5 relief of sensitivity to visual stimuli, and 4 complete remission. Comparable numbers for the 12 participants who found VBRT not helpful were 1 (head/body motion), 3 (visual stimuli), and 0 (remission).
**CONCLUSIONS:** This pilot study offers the first data supporting the habituation form of VBRT for treatment of PPPD.

Keywords: Persistent postural-perceptual dizziness, chronic subjective dizziness, habituation, vestibular rehabilitation

## 1. Introduction

Persistent postural-perceptual dizziness (PPPD), formerly chronic subjective dizziness, is a condition of persistent, non-vertiginous dizziness or unsteadiness that are exacerbated by upright posture, an individual's own motion, objects moving in the environment, and exposure to complex visual stimuli. PPPD is a long-term ($>$ 3 months) vestibular condition that typically is triggered by an acute or episodic vestibular disorder (e.g., vestibular neuritis, benign paroxysmal positional vertigo, vestibular migraine), but also may start after other medical or psychiatric events that cause acute vestibular symptoms or problems with balance (e.g.,

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syncope, mild traumatic brain injury, panic attacks). PPPD may persist after complete resolution of a single triggering event (e.g., neuritis), in which case it is responsible for persistent symptoms that may last for years, or it may co-exist with an episodic disorder (e.g., migraine), in which case it is responsible for daily or near-daily symptoms that persist between recurrences of the comorbid condition. PPPD, itself, does not produce abnormalities in basic vestibular or oculomotor reflexes such as the vestibulo-ocular reflex or smooth pursuit, but individuals with PPPD may show peripheral or central vestibular deficits related to their triggering or co-existing conditions [16,17]. PPPD is closely related to the older concept of phobic postural vertigo, with which it shares key physical symptoms of space-motion discomfort and visually induced dizziness (aka visual vertigo). Individuals with PPPD may be diagnosed incorrectly with psychogenic dizziness, an outdated concept, though approximately three-quarters of individuals with longstanding PPPD have co-existing anxiety or depressive symptoms [12,13,15].

Two treatments have been used for PPPD, medications from the classes of selective serotonin reuptake inhibitors (SSRIs) and serotonin norepinephrine reuptake inhibitors (SNRIs), and the habituation form of vestibular and balance rehabilitation therapy (VBRT). The use of SSRIs/SNRIs is supported by the results of seven open label studies, but there have been no systematic investigations of VBRT specifically for PPPD [2,19,20]. Traditional VBRT programs include exercises for gaze stabilization, habituation, balance, and gait. Gaze stabilization exercises are effective in promoting compensation for peripheral or central vestibular deficits, which work well for individuals who have demonstrable uncompensated abnormalities. Gaze stabilization exercises have not been found, on an anecdotal basis, to be effective for individuals with PPPD. VBRT originally was developed as a habituation or desensitization intervention for individuals with chronic dizziness, though not specifically PPPD. Habituation, which is defined as a process of physiologic fatigue of a reflexive response, uses repeated exposure to stimulate reductions in undesirable response patterns [5,11]. The chronic hypersensitivity to motion stimuli and visual complexity that are core symptoms of PPPD indicate the need for a habituation/desensitization approach, not a compensation approach to VBRT. Habituation exercises are carried out in a graded fashion to motions that increase symptoms. These motions may be head/body motions or movement of objects in the environment. The effect of habituation tends to be specific to the motion executed so exercises are specific to motions that aggravate symptoms [4,5].

Several studies have looked at the use of habituation for treating chronic, non-specific dizziness, but not PPPD per se [7–9,21]. Other studies have investigated habituation for visually induced dizziness, one of the symptoms of PPPD [6,10]. The primary aim of this study was to look for evidence that the habituation form of VBRT may be effective for treating PPPD in 2 well-characterized groups of individuals: individuals with PPPD alone and individuals with PPPD plus other active vestibular disorders or vestibular deficits. The secondary aim was to identify variables that may be associated with VBRT being helpful. We hypothesized that we would find VBRT to be helpful for individuals with PPPD, but that the presence of comorbid conditions might limit the benefit.

## 2. Methods

This was a retrospective chart review and phone survey of individuals seen at Mayo Clinic in Rochester Minnesota between April 1, 2008, when the current protocol for treatment of PPPD (habituation VBRT with or without SSRI/SNRI medications) was first used, and Dec. 31, 2012. The end date was chosen so that individuals who had less than 6 months to perform habituation exercises would not be contacted for the survey. Initial screening of medical records identified over 800 individuals who had been evaluated by a physical therapist for vestibular symptoms or gait problems during the study period. Selection criteria for this pilot study entry were narrowly and strictly established to maintain the focus on PPPD as a principal diagnosis and limit the presence of confounds that might influence treatment adherence or outcomes. Inclusion criteria were: (1) adults $\geqslant$ 18 years of age; (2) diagnosis of PPPD made in accordance with the latest published description of the disorder [8]; (3) PPPD judged to be the principal cause of participants presenting vestibular symptoms; (4) completion of self-report measures of dizziness handicap, anxiety, and depression, and (5) completion of clinical evaluations by specialists from all disciplines comprising our integrated neurotology team (neurotologists, audiologists, physical therapists, and psychiatrists/psychologists experienced in examining individuals with vestibular symptoms). Potential participants were evaluated according to clinical need using an inter-departmental triage pro-

tocol. All potential participants did not see all specialists. For this study, only individuals who were seen by specialists from all disciplines were included to ensure consistency and completeness of clinical data. Exclusion criteria were: (1) uncompensated peripheral or central vestibular disorders; (2) neurologic and orthopedic conditions that persistently affected gait or balance [episodic conditions causing no interictal deficits (e.g., vestibular migraine) were not excluded]; (3) functional neurologic disorders; (4) need for physical therapy interventions other than VBRT; and (5) inability to answer survey questions. The Mayo Clinic Institutional Review Board approved the study.

The record review identified 54 potential participants who met these strict inclusion and exclusion criteria. The initial study plan targeted individuals with PPPD alone (typically triggered by anxiety disorders or minor vestibular events producing no residual deficits) and PPPD arising from the three most common medical triggers of the disorder (moderate to severe vestibular events, vestibular migraine, and mild traumatic brain injuries). Too few potential participants with brain injuries who had fully recovered from all symptoms other than dizziness were found, so that group was eliminated. Individuals with PPPD triggered by vestibular events were identified by the presence of fully compensated, unilateral peripheral vestibular deficits. Individuals with histories suggestive of acute vestibular events, but showing no physical examination or laboratory evidence of deficits were included in the PPPD alone group. Individuals with PPPD plus vestibular migraine were identified using consensus criteria for vestibular migraine recently published by the International Headache Society [1].

Potential participants were phoned and asked to participate in a survey about their use of VBRT exercises and response to treatment (Appendix 1). The survey occurred an average of 27.5 months after individuals' evaluations (range 8–57 months). Only those answering the phone survey and returning a signed authorization form were included in the final study cohort. Thirty-five potential participants (65%) responded to the survey, an acceptable response rate for a study of this type. Six answered the survey questions, but did not return the mailed authorization form. One declined to participate and 2 withdrew from the study after answering survey questions, but before returning written authorization. Therefore, the final study cohort included 26 individuals who responded to the phone survey and returned written authorization including 12 with PPPD alone, 8 with PPPD plus vestibular migraine, and 6 with PPPD and vestibular deficits (Fig. 1). Due to the small sample size in each group, the second and third groups were combined to facilitate a comparison between participants with uncomplicated PPPD and those who had identifiable vestibular conditions past or present that could affect response to VBRT.

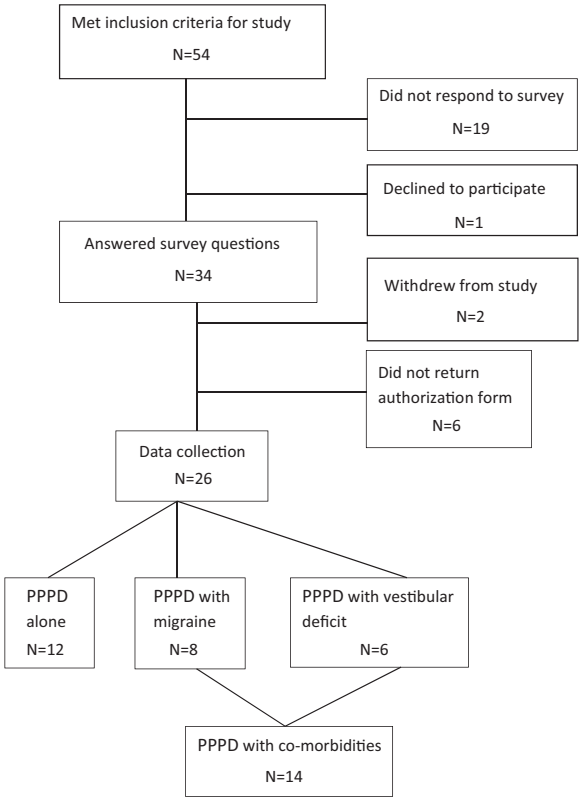


Fig. 1. Study flow chart.

Characteristics of participants are described in Table 1. Mean age was 52.6 ± 14.2 with a range of 26–77 years. Equal numbers of males and females (13/13) participated. Twenty -four identified themselves as white and 2 were unknown. Mean duration of illness was 3.8 ± 3.7 years with a range of 0.5–15 years. All participants reported sensitivity to visual motion, visual complexity, visual patterns, visual tasks, or head and body motion. Twenty of 26 took SSRIs or SNRIs, 1 took a benzodiazepine, and 8 took medication for migraines. Mean Dizziness Handicap Inventory score (DHI) [3] was 54.9 ± 19.7 with a range of 22–86. Mean Hospital Anxiety and Depression Scale (HADS) [24] score was 16.0 ± 7.7 with a range of 4–30. Moderate anxiety or depression was reported in 16 of 26.

Table 1
Characteristics of individuals treated with VBRT

| | | | |
|---|---|---|---|
| Age (years, mean ± s.d., range) | | 52.6 ± 14.2, 26–77 | |
| Sex (F/M) | | 13/13 | |
| Race (White/Unknown) | | 24/2 | |
| Duration of illness (years, mean ± s.d., range) | | 3.8 ± 3.7, 0.5–15 | |
| Sensitive to: (yes/no) | | Yes | No |
| | Visual motion | 19 | 7 |
| | Visual complexity | 21 | 5 |
| | Visual patterns | 8 | 18 |
| | Visual tasks | 11 | 14 |
| | Head motion | 20 | 5 |
| | Body motion | 15 | 11 |
| Medications (yes/no) | SSRI/SNRI | 20 | 6 |
| | Benzodiazepine | 1 | 25 |
| | Migraine treatment | 8 | 18 |
| DHI total score (mean ± s.d., range) | | 54.9 ± 19.7, 22–86 | |
| HADS total score (mean ± s.d., range) | | 16.0 ± 7.7, 4–30 | |
| Moderate anxiety/depression (yes/no) | | 16/10 | |

Table 2
Type of VBRT exercises

| Type | Number of participants |
|---|---|
| Balance (Tandem, Romberg, single leg stance-on dominate and non-dominate leg) | 15 |
| Habituation to visual stimulus (spinning umbrella-in either direction) | 16 |
| Habituation to head/body motion (pitch and yaw plane motions | 18 |
| Habituation to complex environment (store walking) | 17 |
| VOR X1 | 4 |
| Diaphragmatic breathing (in standing during each balance exercise) | 1 |
| Aerobic exercise (general instructions for conditioning) | 3 |
| Neck stretches (ROM and stretching) | 1 |

All participants were seen for evaluation and treatment in VBRT. Twenty-four were seen for one session, 1 for 3 sessions, and 1 for 7 sessions. The sessions included education about the use of VBRT for treatment of PPPD and exercise instruction that was tailored to the specific needs of each participant. Exercises performed by study participants included balance (15), visual habituation for motion and patterns (16), habituation for head and body motion (in pitch and yaw planes) (18), Habituation for complex environment (17), VOR (4), diaphragmatic breathing (1), aerobic exercise (3), and neck stretches (1) (Table 2). Balance exercises included Romberg, Tandem Romberg, and single leg stance. Participants were instructed to do one minute of each exercise twice daily. Habituation to visual motion sensitivity was achieved using a spinning golf umbrella with stripes. Participants were instructed to spin a patterned umbrella (of any size with patterns or stripes) in either direction while seated as long as it was comfortable and to increase speed and time up to 2 minutes then to do the exercise in standing. This was done twice a day. Habituation to complex environments was accomplished by having participants walk into busy environments such as a grocery store until symptoms increased. They were instructed to walk with casual side to side head movements until their symptoms started to increase, then stop and let the symptoms return to the baseline level present at the start of the walk. Then they were to continue on with the walking for that same length of time for 3 more repetitions resting between each. This was done 2–3 days/week. Every 2 weeks they were instructed to increase the length of their walk by 2–4 minutes until they were able to walk 30 minutes without symptoms. Diaphragmatic breathing was used for one participant with an elevated anxiety level during the evaluation process. She practiced diaphragmatic breathing during her balance exercises in standing and was instructed to maintain for the entire length of the exercise (one minute each). Three participants were instructed to perform aerobic exercise for conditioning. No specifics were provided on time or target heart rate. Neck exercises were provided to one participant who had neck pain that may have been contributing to her dizziness. Neck exercises included range of motion and stretching performed twice a day.

Table 3
Participant ratings of benefits of physical therapy consultation

| | Number of subjects | Exercises beneficial | PT consultation beneficial |
|---|---|---|---|
| Exercises extremely helpful | 5 | Yes – 14 | Yes – 22 |
| Exercises somewhat helpful | 9 | | |
| Mixed – some exercises helpful, other exercises not helpful | 2 | No – 12 | |
| Education helpful, exercises not helpful | 6 | | |
| Not helpful at all | 4 | | No – 4 |

We used descriptive analysis to report frequency of response from all participants and helpfulness of VBRT. Students' t-test was used for age, DHI, and HADS scores. Chi-square or Fisher's Exact tests were used for all other analysis.

## 3. Results

Fourteen of the 26 participants rated exercise as beneficial (Table 3). Twenty-two rated the PT consultation beneficial. Eight of 12 in the PPPD alone group and 6 of 14 in the PPPD with co-morbidity group rated VBRT as helpful, but the proportion of positive responses did not differ between the two groups (Table 4). There were no significant differences between those who found VBRT helpful and those who found VBRT not helpful in relation to age, sex, duration of illness, visual or head/body sensitivity, course (intermittent or continuous), DHI scores, and HADS scores for anxiety. The mean HADS score for depression was $8.3 \pm 3.9$ for those who found VBRT helpful compared to $4.7 \pm 3.6$ for those who found VBRT not helpful ($p < 0.05$).

Mean post treatment symptom ratings for head/body motion were $1.9 \pm 2.3$ for those helped by VBRT helpful and $4.5 \pm 3.6$ for those not helped by VBRT ($p < 0.05$). Visual symptoms ratings were $2.9 \pm 2.7$ in those finding VBRT helpful compared to $5.1 \pm 3.3$ by those not helped by VBRT ($p < 0.10$) (Table 4). Five of 14 of those helped by VBRT reported complete relief of visual symptoms compared to 3 of 12 not helped by VBRT. This difference was not significant. Seven of 14 helped by VBRT reported complete relief to head/body motion sensitivity compared to 1 of 12 reporting no help by VBRT ($p < 0.05$). Four of 14 helped by VBRT reported complete remission of all symptoms compared to zero of 12 not helped by VBRT ($p < 0.05$).

## 4. Discussion

This is the first study of outcomes of VBRT for individuals with PPPD. It is likely that previous studies of individuals with chronic non-specific dizziness [7–9,21] or visually induced dizziness [6,10] included at least some individuals with PPPD, but no previous study focused exclusively on the use of PT interventions for individuals with well-characterized PPPD. Our results showed that most participants benefited from VBRT exercise and even more from the PT consultation. We hypothesized that individuals in the PPPD alone group would show greater improvement than individuals in the PPPD with co-morbidities group, but this was not the case, though the absence of a significant between group difference may have been due in part to the small study sample. All individuals helped by VBRT showed a reduction in sensitivity to both head/body motion and visual motion. Post-treatment symptoms ratings were lower (i.e., better) for sensitivity to head/body motion than visual motion and the latter showed only a trend toward a difference between those helped versus not helped by VBRT. This suggests that individuals with PPPD may experience a better response to habituation to head/body motion than to visual motion. Individuals who reported benefit from VBRT had an average HADS depression score just above the cutoff for clinically significant symptoms (i.e., $\geqslant 8$), indicating that mild depression was not a barrier to achieving a positive response.

From a mechanistic standpoint, habituation exercises are more appropriate for PPPD than compensation exercises [18]. Most individuals with PPPD do not have vestibular deficits, and the majority of those with laboratory abnormalities show adequate compensation for deficits in basic oculomotor and postural control reflexes despite their ongoing symptoms. We used gaze stabilization exercises for a few individuals who reported symptoms triggered by rapid head movements, but the exercises may have been doing more to habituate these individuals to head motion than to improve their VOR as they had no physical exam or laboratory evidence of uncompensated deficits in VOR function.

There was strong adherence to the exercise program with 24 of 26 participants doing the exercises at least 3 days a week. This was in spite of most being seen for only one visit. The majority of participants performed

Table 4
Participant's characteristics and treatment outcomes

| Demographic and clinical characteristics | | VBRT helpful ($N = 14$) | | VBRT not helpful ($N = 12$) | | Significance* level |
|---|---|---|---|---|---|---|
| Age (mean ± s.d.) | | 49.5 ± 13.9 | | 56.3 ± 14.3 | | n.s. |
| Sex (F/M) | | 7 female/7 male | | 6 female/6 male | | n.s. |
| Duration of illness (mean ± s.d.) | | 4.5 ± 4.2 | | 2.8 ± 3.0 | | n.s. |
| Course (continuous/intermittent) | | 11 continuous | 3 intermittent | 8 continuous | 4 intermittent | n.s. |
| Symptom present (yes/no) | | yes | no | yes | no | |
| Visual motion | | 11 | 3 | 8 | 4 | n.s. |
| Visual complexity | | 11 | 3 | 10 | 2 | n.s. |
| Visual patterns | | 6 | 8 | 2 | 10 | n.s. |
| Visual tasks | | 5 | 8 | 6 | 6 | n.s. |
| Head motion | | 7 | 7 | 8 | 4 | n.s. |
| Body motion | | 10 | 3 | 10 | 2 | n.s. |
| PPPD (alone/with comorbidity) | | 8 alone | 6 with comorbidity | 4 alone | 8 with comorbidity | n.s. |
| DHI total (mean ± s.d.) | | 50.7 ± 20.7 | | 60.2 ± 17.9 | | n.s. |
| HADS – anxiety (mean ± s.d.) | | 10.6 ± 4.3 | | 7.9 ± 4.4 | | n.s. |
| HADS – depression (mean ± s.d.) | | 8.3 ± 3.9 | | 4.7 ± 3.6 | | $p < 0.05$ |
| Treatment outcomes | | | | | | |
| Post-treatment symptom rating | Visual | 2.9 ± 2.7 | | 5.1 ± 3.3 | | $p < 0.10$ |
| (mean ± s.d.) | Head/body | 1.9 ± 2.3 | | 4.5 ± 3.6 | | $p < 0.05$ |
| | | yes | no | yes | no | |
| Symptom relief (yes/no) | Visual | 5 | 9 | 3 | 9 | n.s. |
| | Head/body | 7 | 7 | 1 | 11 | $p < 0.05$ |
| | Complete | 4 | 10 | 0 | 12 | $p < 0.05$ |

*Students' t-test for age, DHI and HADS scores, Chi-square or Fisher's Exact test for others.

balance and habituation exercises. A minority ($\leqslant 4$ each) performed gaze stabilization, relaxation, aerobic, breathing, and stretching exercises as an adjunct to the primary focus on habituation. Further study might find a larger role for these adjunctive exercises especially relaxation and breathing exercises. Two previous studies showed that relaxed breathing was able to afford protection from symptoms of motion sickness or nausea by delaying onset of symptoms, reducing intensity of symptoms, and shortening recovery time [22,23]. Nausea is not prominent in individuals with PPPD, but some experience mild symptoms akin to motion sickness when undertaking exercise programs.

There were several limitations to this study. The sample was small and not generalizable to a full tertiary care practice as we purposely excluded individuals with complex presentations. This method is proper for a pilot study designed to search for the first signal of efficacy in a well-characterized group of individuals with few confounding variables. The results cannot be used to make definitive statements about the efficacy of VBRT for PPPD, but may guide the design of future investigations. The study also was limited by recall bias, as the average time between evaluation and phone survey was 27.5 months with a range of 8–57 months. Most participants took medication for their dizziness and no comparisons were available to control for this. As is typical of patients seen in the author's practice, most participants in the study cohort were taking medications, particularly SSRIs, that can have a positive effect on PPPD at the time that they received VBRT. It is impossible to completely separate the effects of co-administered treatments in a retrospective design. However the average improvement achievable with SSRIs is a 50% reduction in symptom severity [14]. Therefore, it is unlikely that either substantial clinical improvement or the positive regard individuals reported for education provided by their physical therapists were due soley to medication. Future clinical trials will have to control for medication effects in design or analysis. Finally, most participants were seen for one visit in vestibular rehabilitation, and then conducted their home exercise program without additional professional guidance. Self-reported treatment adherence was excellent, but it is impossible to know if the program was performed correctly or progressed appropriately. Supervised treatment could potentially improve outcomes.

Future prospective studies with larger sample sizes are needed to test the effectiveness of VBRT for PPPD including proper controls for comorbidity, medication use, treatment adherence, professional supervision, and adjunctive techniques.

## 5. Conclusions

Our study showed that the majority of individuals with PPPD found a vestibular habituation exercise pro-

gram helpful and most found the PT consultation beneficial. Greater improvements were made with sensitivity to head/body motion than to visual stimuli. This study is an important first step in determining the effectiveness of using habituation exercises for treating individuals with PPPD. Future research with larger sample sizes and proper control groups would help to delineate the best approach to treating PPPD with physical therapy.

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## Appendix

*Survey questionnaire*

1. How often did you do your exercises?
   a. 5–7 days/week
   b. 3–4 days/week
   c. 1–2 days/week
   d. I did not do the exercises
2. How helpful was the therapy?
   a. Extremely helpful
   b. Somewhat helpful
   c. Patient education helpful, but not the exercises
   d. Made symptoms worse
3. On a scale of 0–10 where 0 is no visual sensitivity and 10 is extreme visual sensitivity, rate your level of visual sensitivity today. Is the visual sensitivity related to movement, complexity, or patterns?
4. On a scale of 0–10 where 0 is no head motion sensitivity and 10 is extreme head motion sensitivity, rate your level of head motion sensitivity today.

5. Disability scale[1]
   a. 0-No disability; negligible symptoms
   b. 1-No disability; bothersome symptoms
   c. 2-Mild disability; performs usual work duties, but symptoms interfere with outside activities
   d. 3-Moderate disability; symptoms disrupt performance of both usual work duties and outside activities
   e. 4-Recent long term disability; on medical leave or had to change job because of symptoms
   f. 5-Long term disability; unable to work for over one year or established permanent disability with compensation payments
6. Symptom scale[1]
   a. 0-No symptoms remaining at the end of therapy
   b. 1-Marked improvement in symptoms, mild symptoms remaining
   c. 2-Mild improvement, definite persistent symptoms remaining
   d. 3-No change in symptoms relative to pre-therapy period
   e. 4-Symptoms progressively worsen over course of therapy relative to pre-therapy levels
7. Did you get any other vestibular rehabilitation?
8. Did you take medication for dizziness? What? How long? Are you still taking medication?

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