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Original Article

Does the Self-training in Ménière's Disease Fit the Disease Characteristics and Help Alleviate the Balance Problems?

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BACKGROUND: To examine whether the self-initiated exercise in Ménière's disease fits the characteristics of the balance problems.

METHODS: This retrospective study included 539 people with Ménière's disease belonging to the Finnish Ménière Federation. The mean age was 61.9 years with a mean history of Ménière's disease of 15.6 years. The data were collected with an online questionnaire.

RESULTS: In total, 30% of the patients did not do any training, 23% did training once a week, 22% did 2-3 times a week, and 26% did the training daily. The most common training exercises were different self-training exercises (26%) followed by walking (16%), guided training (15%), viewing plus balance training (10%), and viewing training (4%). *Non-defined balance problems* (18%) were associated with recent vertigo attacks. *Swaying* type of balance problems were present in 23% and they used all types of training programs. *Rocking* type of balance disorder was present in 8% and they preferred guided training exercises. *Tripping off* type of balance disorder was present in 25% and they preferred viewing plus balance training.

CONCLUSIONS: The type of self-training used was related to the type of balance problems reported. When choosing the vestibular rehabilitation in Ménière's disease , the type of balance disorder should be characterized and the rehabilitation program should be individually tailored.

KEYWORDS: Eye movement training, Mal de debarquement syndrome, Ménière's disease, self-administered balance rehabilitation, self-management, uncontrolled manifold, vestibular rehabilitation

INTRODUCTION

Postural complaints outside of the vertigo attacks are often problematic in Ménière's disease (MD).[1] The postural complaints are variable and seemingly non-specifically linked to episodic vestibular derangement or ailment of the otolith system.[2] Several patient organizations provide exercise programs for people with vestibular disorders including MD.[3-5] In addition, vestibular rehabilitation is preferred by most doctors and physiotherapists treating problems associated with vestibular malfunction.[6,7] Usually, the rehabilitation programs contain viewing exercises and balance exercises to improve the visual–vestibular interaction and the static and the dynamic postural stability. Some of these programs are using applied relaxation, challenging negative beliefs, and lifestyle modification to reduce the amplification of dizziness by anxiety.[8] In some of these programs, the focus was on improving coping with the balance problems.[9] However, the vestibular rehabilitation programs may not be effective in MD in restoring gait and balance and do not seem to improve the quality of life of the participants.[10]

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In a recent study evaluating the postural complaints in MD, the balance problems could be classified into 4 major categories: *slow frequency swaying*, *rocking sensation*, *tripping off*, and *non-specific balance problems*.[11] The *tripping off* was most common and was explained to associate with visual and proprioceptive mistrust/ailment on vestibule–spinal function. The *swaying* type of postural problem was also found in a significant number of the participants with MD and was similar to those present in Mal de debarquement syndrome (MdDS).[12,13] The *rocking* type of balance problems was reported less commonly in MD and was related to uncontrolled manifold (UCM) of posture with a low-stiffness strategy of balance control.[14] Finally, *non-defined balance problems* were present in a part of the patients and these were occasional and correlated with vertigo attacks. In few patients with MD, a combination of several postural derangement categories was present.

We hypothesize that rehabilitation programs that are recommended by physicians and patient organizations should be personalized to fit the disease characteristics to be more effective. However, the patterns of self-initiated exercises and their outcomes have not been examined in a structured way, and patient organizations only get to hear anecdotal reports sporadically. The aim of the current study was to examine whether the self-initiated exercise in MD fits the disease characteristics and helps to alleviate balance problems.

MATERIALS AND METHODS

Study Design and Participants

Permission was obtained from the Finnish Ménière Federation (FMF; Suomen Meniere-liitto) to analyze the registry data that the FMF had collected from their members. The data were based on an extensive questionnaire on symptoms related to MD. According to Finnish law, this kind of study with registry data conducted by a patient organization, which involved anonymous data, does not require ethical approval. The electronic survey was sent to 1035 out of 1739 members who were available through e-mail. Four email reminders were sent for those who did not respond to the initial request to complete the survey. In total, 539 persons responded (i.e., 52.1% response rate) to the survey. The mean age of the subjects participating in the study was 61.9 years (range: 17-89 years). The duration of the disease on average was 15.6 years (range: 0.5-40 years). The respondents included 423 (79.5%) females and 116 (21.5%) males with respect to the gender distribution of FMF. In our previous studies, we have found that 97% of the FMF members had definite MD and 2.7% probable MD when classified them using the American Academy of Otolaryngology–Head and Neck Surgery (AAO-HNS) diagnostic criteria.[15,16]

Data Collection

The 39-item questionnaire was used for assessing the symptoms and consequences of the disorder. The questions focused on impact, social and economic aspects, and complaints of MD that were specifically related to balance and postural fitness. The patients were asked the following questions: (1) Do you feel that you or support surface would swing slowly (about 0.2 Hz)? (2) Do you feel that you by yourself or support surface would have a rocking sensation (at about 1 Hz)? and (3) Do you feel that your balance problems are mainly caused by tripping off? The frequency and intensity of the balancing problems and their association with visual problems were asked as well. They were also asked about vestibular and visual training types and their frequency and whether the training was guided or self-training was recorded. The impact of the postural complaints was rated on a 4-step scale from "no impact" to "severe impact." The Visual Analog Scale (VAS) scale from EuroQol EQ-5D-3L was used to measure the health-related quality of life (HRQoL).[1] In addition, an open-ended question was provided for commenting on the training.

As the viewing exercise groups were divided into several related activities with a relatively small number of subjects (see Figure 1), the training groups were regrouped by combining viewing exercises with different training groups to one. The guided training groups with self-training were also combined in further statistical workup to the guided training group. Thus, the final training groups contained 5 different training groups in statistical workup: *no training, viewing exercises, viewing exercises with balance training, guided training, self-training, and walking groups*.

Classification of the Training

Of the 539 participants, 161 (29.9%) did not do any training (non-trainers), whereas the rest of the participants could be categorized into 5 training groups as summarized in Table 1. In *viewing exercises,* the subjects followed the instructions provided by the local patient organization (i.e., FMF). In *guided training,* the participants did yoga, pilates, fitness classes, or supervised balance-focused training. *Self-training* was performed most commonly in fitness and training centers and less frequently at home and consisted of various muscle strength and physical fitness exercises. *Walking* was carried outdoors on paved roads or on terrains. Often, the subjects had other additional training elements as walking or biking combined with *viewing exercises*. Of the 378 (70.1%) participants who did some training, 122 (22.6%) participants exercised once a week, 116 (21.5%) participants exercised 2-3 times a week, 130 (24.1%) participants exercised daily, and 10 (2%) participants exercised several times a day.

Data Analysis

The descriptive statistics were explored. Student's *t*-test and analysis of variance (ANOVA) were used in continuous variables. In comparing groups with continuous variables, ANOVA was used. Non-parametric tests such as the chi-square test, Mann–Whitney *U* test, and Kruskal–Wallis *H* test were used in other variables. In modeling the risk for binary variables, the stepwise logistic regression analysis was used. A *P* value of .05 was used for the interpretation of statistical significance. Answers to open-ended questions were analyzed using the qualitative content analysis and also the frequency of occurrence of each category was noted.

Table 1. Types of Training Activities Among Study Participants

Types of Exercises	Number of Participants	%
No training	161	29.9
Viewing exercises	20	3.7
Guided training	81	15.0
Self-training	139	25.8
Walking	84	15.6
Viewing exercises with balance training	54	10.0
Total	539	100.0

RESULTS

Training Types and Associated Complaints

There were significant differences between the *training types* and the visual complaints, balance problems, vestibular drop attacks (VDA), HRQoL, and fatigue but not in vertigo spells (see Table 2). Vestibular drop attacks were significantly less frequent among those who did not train compared to those with various training. Participants who did balance and viewing exercises had common visual problems and also problems with VDA, fatigue, reduced HRQoL, and impacting balance problems. Guided training, non-guided training, and walking groups tended to have more visual complaints than non-trainers, but in pairwise comparison, the difference was statistically insignificant.

The association between *training frequency* and complaints was demonstrated in Table 3. Visual problems and VDA were positively correlated with the training frequency. Balance problems tended to promote the training but the difference was insignificant. The older subjects and those with a longer duration of MD were trained more frequently than the younger subjects and with a shorter duration of MD. The HRQoL was reduced in all subjects with MD when compared with the normal population and did not explain the frequency of training.

Association Between the Type of Balance Problems and the Type of Training

When exploring the type of balance problems, the participants were classified into (a) swaying, (b) rocking, (c) tripping off, (d) combination of these, and (e) non-defined (see Table 4). No balance problem was reported by 126 (23.4%) participants. The non-defined balance problem group was further analyzed and showed that of the 95 participants, 91 had experienced balance problems rarely and 4 participants experienced balance problems weekly.

When comparing the characteristics of the balance disorder and different training types, significant differences among the participants were observed in swaying type of postural instability ($H = 15.987$, $P = .003$), in rocking type of postural instability ($H = 15.121$, $P = .004$), and in tripping type of postural derangement ($H = 16.921$, $P = .002$) but not in non-defined type of postural instability ($H = 8.116$, $P = .087$). In pairwise comparison (see Figure 1A-D), participants with rocking type of balance problems more frequently used guided training. Participants with swaying and tripping type of balance problems used all exercise strategies more commonly than those with no balance problems.

When comparing the characteristics of the balance disorder and different frequency of exercises, there were significant differences in

Table 2. Association Between Complaints and Various Training Interferences. For Non-Parametric Variables, Mann–Whitney *U* Test was Used, and for Continuous Variables, Bonferroni Test was used. The Group Differences were Explored by Chi-Square Test and ANOVA

Characteristics of the Problem	No Training (n = 161)	Eye and Balance Training (n = 74)	Guided Training (n = 81)	Non-Guided Training (n = 139)	Walking (n = 84)	All (n = 539)	χ^2 Test or *F* Test Values, *P*
Vision unstable	16%	31%*	23%	17%	5%	20%	$\chi^2 = 7.283$ $P = .122$
Items float or move	5%	15%*	11%	9%	25%	8%	$\chi^2 = 7.785$ $P = .100$
Problems in focusing	19%	45%***	35%	26%	13%	27%	$\chi^2 = 17.626$ $P < .001$***
VDA	37%***	61%*	53%	45%	52%	47%	$\chi^2 = 11.046$ $P = .026$*
Personal Computer (PC)-problems	9%	18%*	9%	13%	7%	11%	$\chi^2 = 6.776$ $P = .148$
Fatigue	30%	41%*	32%	32%	25%	32%	$\chi^2 = 4.175$ $P = .383$
Vertigo spells	42%	43%	32%	39%	39%	40%	$\chi^2 = 1.220$ $P = .875$
Impacting balance	54%	69%*	60%	52%	50%	56%	$\chi^2 = 7.824$ $P = .092$
Car driving	4%	3%	2%	5%	4%	18%	$\chi^2 = 6.912$ $P = .141$
HRQoL VAS score	70.1	61.1*	73.4	71.8	63.2*	68.9	$F = 4.848$ $P = .001$***
Age, years (mean)	60.0	62.6	59.3	62.9	64.6*	62.2	$F = 3.529$ $P = .007$**
Duration of MD years (mean)	13.5	16.6	15.8	16.1	17.0	15.6	$F = 2.069$ $P = .084$

*Statistical significance for pairwise comparison.
*$P < .005$, **$P < .01$, ***$P < .001$.
ANOVA, analysis of variance; VDA, vestibular drop attacks; HRQoL, health-related quality of life; MD, Ménière's disease.

Table 3. Association Between Complaints and Training Frequencies. For Non-Parametric Variables, Mann–Whitney *U* Test was Used, and for Continuous Variables, Student's *t*-Test was Used. The Group Differences were Explored by Chi-Square Test and ANOVA Between the Training Groups and Non-Trainers

Characters of the Problem	No Training (n = 161)	Training Once a Week (n = 112)	Training 2-3 Times a Week (n = 116)	Training Daily (n = 149)	All (n = 539)	χ^2 or *F* Test Values, *P*
Vision unstable	16%	21%	23%	23%*	20%	$\chi^2 = 4.285$ $P = .044$
Items float or move	5%	13%*	7%	9%	8%	$\chi^2 = 5.453$ $P = .141$
Problems in focusing	18%	38%***	32%**	28%*	28%	$\chi^2 = 12.291$ $P < .006$**
VDA	37%	58%**	46%	52%***	47%	$\chi^2 = 12.530$ $P = .006$**
PC-problems	9%	8%	14%	13%	11%	$\chi^2 = 6.491$ $P = .165$
Fatigue	30%	41%	28%	29%	32%	$\chi^2 = 4.432$ $P = .080$
Vertigo spells	43%	42%	39%	36%	40%	$\chi^2 = 0.725$ $P = .394$
Impacting balance	54%	58%	60%	53%	56%	$\chi^2 = 1.511$ $P = .680$
Car driving	13%	22%*	16%	21%*	18%	$\chi^2 = 5.951$ $P = .080$
HRQoL VAS score	70.1	69.8	69.1	66.6	68.9	$F = 0.639$ $P = .590$
Age, years (mean)	60.6	60.9	61.6	64.6**	62.2	$F = 4.454$ $P = .004$**
Duration of MD years (mean)	13.5	14.9	17.0*	17.5**	15.6	$F = 3.875$ $P = .009$**

*Statistical significance for pairwise comparison.
*$P < .005$, **$P < .01$, ***$P < .001$.
ANOVA, analysis of variance; VDA, vestibular drop attacks; HRQoL, health-related quality of life; MD, Ménière's disease.

participants with non-defined balance problem ($H = 6.937$, $P = .008$), in swaying type of balance problem ($H = 6.418$, $P = .011$), and in tripping type of balance problem ($H = 27.726$, $P = .005$) but not in participants with rocking type of balance problems ($H = 2.432$, $P = .119$). In pairwise comparison (see Figure 2), the participants with swaying and tripping type of balance problems and those with non-defined balance problems were trained more frequently than subjects with no balance problems.

DISCUSSION

In the present study, we evaluated whether the exercise habits would reflect the complaints experienced as problematic in MD and whether the type of exercise would reflect the character of postural derangement. The individual driving force for exercises was visual complaints, problems associated with VDA, and poor HRQoL, especially for participants using viewing exercises and balance training. The elderly and those with poor HRQoL tended to use frequent walking exercises instead of guided or non-guided training. The selection between guided training and non-guided training was not obvious and may depend on human factors and the availability of suitable training facilities. We also found that the elderly and those with a longer duration of MD exercised more. However, vertigo attacks were not associated with training habits.

Table 4. Classification to Different Types of Balance Problems Among Study Participants

Type of Balance Derangement	Number of Participants	%
No balance problem	126	23.4
Swaying	122	22.6
Rocking	44	8.2
Tripping	135	25.0
Swaying and tripping	12	2.2
Rocking and tripping	5	.9
Non-defined	95	17.6
Total	539	100.0

Regarding the correlation of the different types of balance derangements with training habits, participants with *swaying type* of balance disorder were trained weekly or daily and mostly used all different training methods without prioritizing. The participants with *rocking type* of balance disorder mainly used guided training but the frequency of training was not different from those not having balance problems. Those with *tripping off* type of balance disorder were trained frequently and used all training types more often than those with no balance problems, but they also preferred to use viewing exercises with balance training. The participants with non-defined balance problems differed in their training habits from patients with no balance problems. The training types did not respect the training demands determined by the characteristics of postural derangement as *tripping off, swaying, or rocking* sensations.

There are few studies exploring the efficacy of vestibular rehabilitation in MD. Nyabenda et al[17] used rotational stimuli and optokinetic stimuli to rehabilitate the MD. In another study, Garcia et al[18] used conservative therapy and applied virtual reality stimulation in vestibular rehabilitation. They reported improved vestibular control of balance. Due to the fluctuating nature of the MD, Gottshall et al[19] advocated that before commencing the balance rehabilitation program the vertigo attacks should be abated by therapy. The authors demonstrated that after vestibular function stabilization with steroids, the intervention with exercises was effective in 88% of the patients with MD. Perez et al[20] analyzed the effects of selected training on patients treated with intratympanic injections with gentamicin or with surgical labyrinthectomy and noted improvements in 73% of the participants. These patients are more akin to patients with a fixed vestibular deficit, for which vestibular rehabilitation has been shown to be helpful.[6] This is not the case in MD, as most individuals with MD will have at least part of the vestibular function preserved. In a recent review,

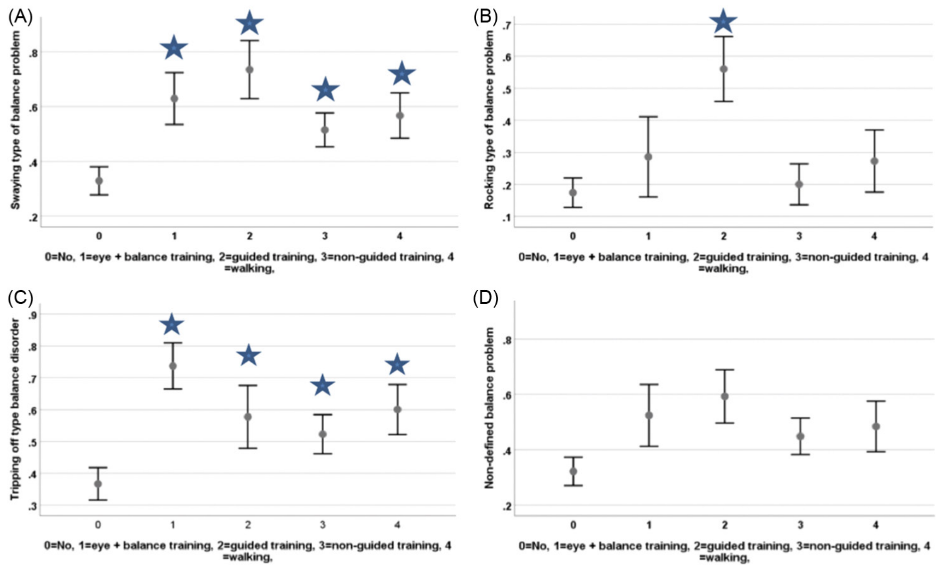

Figure 1. Exercise methods used by participants with different types of balance disorders. Exercises used in (A) swaying type of balance disorder, (B) rocking type of balance disorder, (C) tripping type of balance disorder, and (D) non-defined balance disorder.

van Esch et al[10] examined the outcome of vestibular rehabilitation in MD, and the effect of vestibular rehabilitation on improving the balance and HRQoL was inconclusive. Therefore, vestibular rehabilitation should only be avoided during acute attacks of MD as recommended in a recent clinical practice guideline for MD.[21]

Kentala et al[22] demonstrated that among patients with MD, exercise was ranked high as a self-help method, and 50% of the study participants used either general (35%) or specific exercises (15%) to alleviate their balance problems. The patients with MD are mostly willing to improve their situation and perform exercises as in the present study (70%). For patients with MD, several types of training programs have been advocated by patient organizations including guided training programs (e.g., Asahi, Yoga, Nintendo Wii, and Tai Chi), web-based home training programs (e.g., from FMA-home page and YouTube videos), and general non-guided physical training programs (e.g., walking in terrains and fitness clubs). So far, the instructions delivered by patient organizations or rehabilitation centers do not recognize different characteristics of balance disorders. There is a need that such programs should be established as the current suggestions of balance training that seem to base on the outcome of experiments received from the rehabilitation of permanent vestibular function loss. Thus, non-specificity of the training programs may explain why the conventional rehabilitation programs are not effective in the management of individuals with MD.[10]

The characteristics of postural instability in the present study with *swaying* sensation indicate that one-fourth of the subjects with MD had this type of postural derangement. The slow frequency *swaying type* of balance disorder mimics the balance problems reported by those with MdDS. Based on animal experiments, one of the etiological factors for MdDS has been suggested to depend on poor

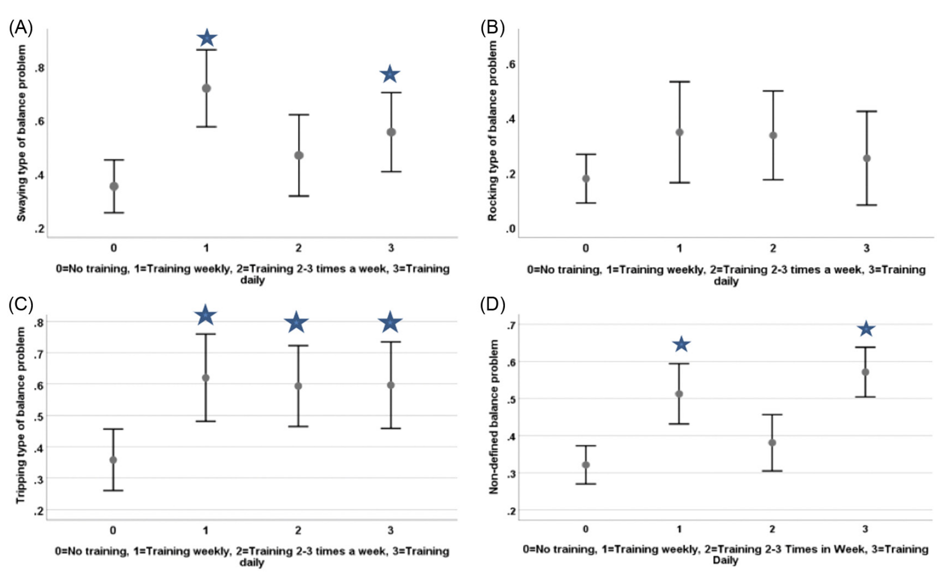

Figure 2. Frequency of exercise used by participants with different types of balance disorders. Frequency of exercises used in (A) swaying type of balance disorder, (B) rocking type of balance disorder, (C) tripping type of balance disorder, and (D) non-defined type of balance disorder.

synchronization between otolith afferents in the saccule and utricle and semicircular canal system.[23] In individuals with MdDS, rehabilitation is used with head tilting within a moving optokinetic drum.[24] A recent study demonstrated a significant correlation of swaying with visual complaints and indicated that visual and postural interaction was problematic in MD.[11] In MD subjects with *swaying* type of balance problem, rehabilitation for visual training might be useful. However, Tsutsumi et al[25] reported that in normal subjects, optokinetic stimulation mostly improved postural stability, whereas in vestibular-impaired patients, stimulation diminished postural stability. However, the test was not used for rehabilitation purposes. So far, there are no systematic studies to compare the outcome of vestibular training in MD with the model provided by MdDS.

The UCM component of the experimental sway could be considered as passive dynamics with no active control, the same way as moving attractors in other work.[14,26] The UCM component mainly consists of high-frequency oscillations above 1 Hz, corresponding to anti-phase coordination between the ankle and the hip.[14] This type of postural instability is similar to the *rocking type* of balance problems in the present study. In this postural derangement, the passive dynamics of posture could oscillate freely until dynamic UCM will intervene and restore the control. The angular acceleration of the ankle and the hip joints is negatively correlated with each other at a specific ratio, suggesting that such specific coordination might reflect active control of the central nervous system in minimizing the acceleration of the center point of force on posturography.[27] We hypothesize that if the central control is faulty by the disintegration of vestibular control, then the posture becomes unstable and has high oscillation between stability boundaries as in *rocking sensation* in this study. We speculate that to promote vestibular integration with visual and proprioception, blind walking with head movement might be a useful training. Also, memorizing the movement patterns with meditation would promote the outgrowth of neural network controlling posture. More research in this context is needed to prove the validity of this kind of rehabilitation program.

The postural control system has a memory from the past, and the postural control is executed largely by anticipation.[28] Based on vestibular and visual mistrust, the present postural complaints as *tripping off* during movements could be referred to as lack of confidence/control on vestibule–spinal reflexes. Participants with *tripping off* used different training methods. We suggest that for postural perturbation, characterized as *tripping off,* the traditional balance training might be useful.[6,7] Selected training such as blind walking with eye–head coordination training might be the most applicable method although the data of the outcome of training in MD are lacking.

CONCLUSIONS

The driving force for self-initialized attempts to commence exercises could be partially predicted by the impact of balance problems, the severity of the balance problem, poor visual ability to focus under movement, and older age of the participants. In *swaying* type of balance problems, the rehabilitation therapy used for MdDS might be suitable, but this rehabilitation mode was not included in any of the different suggested training programs for MD. In *rocking* type of balance disorders, the suggested model stems from UCM of postural control in that the ankle and hip rotations are desynchronized. For rehabilitation, blind walking with head movement might be useful. Participants with *tripping off* used various training methods. We suggest that for postural perturbation characterized as *tripping off*, the traditional balance training might be useful although selected training as blind walking with eye–head coordination training might be the most applicable method. The *non-defined* balance problems were occasional and mild and occurred after a recent rotatory vertigo attack. We suggest that the type of balance disorder should be characterized, and rehabilitation programs should be tailored to individual needs.

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Conflict of Interest: None.

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