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Comparison of the effectiveness of vestibular rehabilitation on disability and balance in patients with chronic unilateral and bilateral vestibular hypofunction

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ABSTRACT

Aims: This study evaluated the effectiveness of supervised vestibular rehabilitation on disability and balance by comparing patients with chronic unilateral vestibular hypofunction (UVH) and bilateral vestibular hypofunction (BVH).

Methods: This retrospective study included patients aged 18-65 years diagnosed with chronic vestibular hypofunction and underwent a supervised vestibular rehabilitation program. We excluded patients with a history of central nervous system disease, central vestibular pathology, systemic disease, and neck disorders that may cause dizziness and balance disorders, psychiatric disease, cognitive disorder, visual dysfunction, and vestibular disorder with a fluctuating course. The outcome measures were the differences between the Dizziness Handicap Inventory (DHI) for disability and the Berg Balance Scale (BBS) for balance-fall risk scores before and after the rehabilitation program in patients with UVH vs. BVH.

Results: The study included 24 UVH [age, mean±standard deviation (SD): 50.0±12.3 years, women: 75%] and 14 BVH patients (age, mean±SD age: 53.8±12.1 years, women: 64.3%). Baseline demographic characteristics, DHI and BBS scores were similar in the two groups. We observed improvements in DHI (UVH: 67.25±10.43 vs. 51.50±17.03, $p<0.05$; BVH: 63.00±21.12 vs. 44.57±22.90, $p<0.05$) and BBS [UVH: 49 (43.0-51.75) vs. 50.5 (44.75-52.75), $p<0.05$; BVH: 42.07±9.35 vs. 47.86±6.65, $p<0.05$] scores in the two groups after the rehabilitation program. On the other hand, there were no between-group differences in the changes in DHI (UVH: -15.75±13.28 vs. BVH: -18.43±15.79, $p>0.05$) and BBS [UVH: 2 (0-5) vs. BVH: 4 (1.0-9.25), $p>0.05$] scores.

Conclusions: This study found that a supervised 4-week vestibular rehabilitation program was similarly effective in chronic UVH and BVH in disability and balance improvement.

Introduction

Vestibular hypofunction is characterized by impaired vestibular functions due to partial or complete involvement of the peripheral or, rarely, the central vestibular system (1,2). Patients with vestibular hypofunction complain of symptoms such as dizziness, visual and gaze disorders, balance disorders, unsteadiness during walking and standing, and oscillopsia, depending on the type of involvement (unilateral or bilateral) (3,4). Chronic vestibular asymmetry manifests with symptoms and findings such as head movement-induced symptoms, gait instability, oscillopsia, spatial disorientation, and impaired navigation in patients with unilateral vestibular hypofunction (UVH) (1). In contrast, imbalance and oscillopsia with head movement are among the most common symptoms in patients with chronic bilateral vestibular hypofunction (BVH)

(1). Oscillopsia, postural instability, and falls are more frequent among patients with BVH (5).

Vestibular hypofunction negatively affects patients' quality of life and activities of daily living (1). Falls are a serious complication in patients with vestibular hypofunction (6). Considering the consequences on quality of life and overall disease burden, proper diagnostic and therapeutic measures may reduce the adverse outcomes of vestibular hypofunction (7).

Rehabilitation practices have long been used in patients with vestibular hypofunction, with increasing evidence of their effectiveness (5). Exercise programs to improve gaze stability, developed on the concept of vestibulo-ocular reflex (VOR) adaptation and substitution, habituation exercises that aim to reduce symptoms by repeatedly exposing the patient to provocative stimuli, exercises and practices to improve balance and gait quality, and their combinations, are recommended on a person basis (1,5). A recently published clinical guideline strongly recommends vestibular physical therapy in patients with chronic UVH and those with chronic BVH, along with supervised vestibular rehabilitation for patients with peripheral vestibular hypofunction (1).

Although vestibular rehabilitation is recommended and beneficial in patients with both UVH and BVH, most studies have shown that patients with UVH benefit more from vestibular rehabilitation (5).

However, only a limited number of studies have evaluated the effectiveness of supervised vestibular rehabilitation on disability and balance in patients with chronic vestibular hypofunction and have compared the rehabilitation effectiveness in patients with UVH and BVH (1).

We hypothesized that vestibular rehabilitation would benefit patients with chronic vestibular hypofunction and that patients with UVH would benefit more from vestibular rehabilitation than patients with BVH. Therefore, the present study aimed to evaluate the effectiveness of a supervised vestibular rehabilitation program on disability and balance in patients with chronic UVH vs. chronic BVH.

Methods

Study design and participants

This retrospective study included patients with chronic vestibular hypofunction who received a vestibular rehabilitation program at a tertiary center between November 2022 and November 2023. Demographic and clinical data, including age, gender, body mass index, and disease duration, were recorded using the medical records.

The inclusion criteria were age between 18 and 65 years and confirmed diagnosis of chronic vestibular hypofunction according to the video head impulse test [VOR gain of less than 0.7 for the semicircular canal (1)] by the otorhinolaryngology and neurology departments. The exclusion criteria were a history of central nervous system disease, central vestibular pathology, systemic disease that may cause dizziness and balance disorders, or neck disorder that may cause dizziness and balance disorders, being diagnosed with a psychiatric disease, cognitive impairment, impairment in visual functions, or vestibular disorder with a fluctuating course (e.g., Meniere's disease). We compared the results obtained in patients with UVH vs. BVH. The study protocol was approved by the Ethics Committee of Ankara Bilkent City Hospital (decision no: E2-23-5922, date: 27.12.2023). The study conforms to the principles of the Declaration of Helsinki.

Treatment protocol

The vestibular physical therapy program consisted of 12 sessions in 4 weeks. Sessions were planned thrice weekly, and each session lasted 45 minutes under the supervision of the same physiotherapist experienced in vestibular rehabilitation. All patients regularly participated in vestibular physical therapy sessions.

The vestibular physical therapy program included gaze stabilization exercises (e.g., eyes focus on a fixed target while the head moves-VORx1, eyes focus on a moving target while the head and target move in opposite directions-VORx2), habituation exercises, and balance and gait training (e.g., Romberg, tandem, single leg stance, walking with head turns, doing a secondary task while walking), based on the diagnosis, symptoms, and functional status. Therapy sessions consisted of gaze stabilization exercises for approximately 15-20 minutes, habituation exercises (if necessary) for approximately 10 minutes, static and dynamic balance, and gait training for approximately 15-20 minutes with a 5-minute rest period between different exercise types.

Clinical assessment

The outcome measures in the present study were the Dizziness Handicap Inventory (DHI) and Berg Balance Scale (BBS) scores, which were routine before and after a vestibular rehabilitation program (1).

Patients' self-perceived disability due to vestibular disease were evaluated using the DHI scores (8). The DHI is a 25-item test with three domains (functional, emotional, and physical). The scores vary between 0 and 100, with higher scores showing greater perceived handicap due to dizziness. The validity and reliability of the DHI in Turkish patients were performed (9), and the Cronbach alpha values of all sub-dimensions were 0.67 and 0.82.

The balance and fall risk were evaluated using the BBS scores (10). The BBS yields a score between 0 and 56 from 14 activities, with higher scores indicating better balance. The validity and reliability of the Turkish version of the BBS were performed (11), and the intra-class intraclass correlation

coefficient and inter-rater reliability were 0.98 and 0.97, respectively.

Outcome measures

The outcome measures were the differences between the DHI for disability and the BBS for balance-fall risk scores before and after the rehabilitation program in patients with UVH vs. BVH.

Statistical Analysis

Statistical analysis was performed using the SPSS for Mac version 20.0 software (SPSS Inc, Chicago, IL, USA). Descriptive data were expressed as mean±standard deviation (SD) and median (25-75%) values for continuous variables and numbers (%) for categorical variables. The normal distribution of data was assessed using the Shapiro-Wilk test. Intragroup comparisons before and after treatment were performed using the Wilcoxon signed-rank test for non-normally distributed variables and the paired samples t-test for normally distributed variables. Inter-group comparisons were performed using the Mann-Whitney U test for non-normally distributed continuous variables, the independent samples t-test for normally distributed continuous variables, and the Chi-square test for categorical variables. The results were considered statistically significant for $p<0.05$.

Results

Demographic and clinical characteristics

The study included 24 patients with UVH [age, mean±SD: 50.0±12.3 years, 75% women] and 14 patients diagnosed with BVH (age, mean±SD: 53.8±12.1 years, 64.3% women). Baseline demographic characteristics, DHI scores, and BBS scores were similar between the two groups (Table 1).

Intragroup comparisons

There were significant improvements in post-treatment DHI and BBS scores ($p<0.05$) (Table 2) in both groups.

Comparison of the inter-groups

We observed no significant difference between the two groups in terms of changes in DHI and BBS scores ($p>0.05$) (Table 3).

Table 1. Clinical and demographic data of the groups at baseline

	UVH (n=24)	BVH (n=14)	p
Age (years)	50.0±12.3[a] 51.5 (42.5-60.75)[b]	53.8±12.1[a] 58 (49-61.25)[b]	0.243
Sex, n (%) **Women** **Men**	 18 (75.0) 6 (25.0)	 9 (64.3) 5 (35.7)	0.488
BMI (kg/m²)	27.26±7.14[a] 25.16 (22.71-30)[b]	27.28±5.56[a] 26.76 (23.94-29.35)[b]	0.515
Disease duration (month)	11.08±6.34[a] 9 (6-14.25)[b]	12.29±7.47[a] 12 (5.75-19.5)[b]	0.806
DHI	67.25±10.43[a] 67 (60-76)[b]	63.00±21.12[a] 73 (41.5-79)[b]	0.411
BBS	46.08±7.29[a] 49 (43.0-51.75)[b]	42.07±9.35[a] 42.5 (35.5-50.25)[b]	0.192

UVH: Unilateral vestibular hypofunction, BVH: Bilateral vestibular hypofunction, BMI: Body mass index, DHI: Dizziness Handicap Inventory, BBS: Berg Balance Scale
[a]: Mean±standard deviation, [b]: Median (25-75%)

Table 2. Pre-treatment and post-treatment DHI and BBS scores

	Pre-treatment	Post-treatment	p
DHI			
UVH (n=24)	67.25±10.43[a] 67 (60-76)[b]	51.50±17.03[a] 54 (36.5-66)[b]	<0.001*
BVH (n=14)	63.00±21.12[a] 73 (41.5-79)[b]	44.57±22.90[a] 51 (25-66.5)[b]	0.001*
BBS			
UVH (n=24)	46.08±7.29[a] 49 (43-51.75)[b]	49.21±4.62[a] 50.5 (44.75-52.75)[b]	0.001*
BVH (n=14)	42.07±9.35[a] 42.5 (35.5-50.25)[b]	47.86±6.65[a] 49 (45-53.25)[b]	0.001*

UVH: Unilateral vestibular hypofunction, BVH: Bilateral vestibular hypofunction, DHI: Dizziness Handicap Inventory, BBS: Berg Balance Scale
*: Significant difference, [a]: Mean±standard deviation, [b]: Median (25-75%)

Table 3. Comparison of changes in DHI and BBS scores between groups

	UVH (n=24)	BVH (n=14)	p
DHI	-15.75±13.28[a] -16 (-21.5, -8)[b]	-18.43±15.79[a] -19 (-23, -9)[b]	0.58
BBS	3.13±4.31[a] 2 (0, 5)[b]	5.79±5.09[a] 4 (1.0, 9.25)[b]	0.08

UVH: Unilateral vestibular hypofunction, BVH: Bilateral vestibular hypofunction, DHI: Dizziness Handicap Inventory, BBS: Berg Balance Scale
[a]: Mean±standard deviation, [b]: Median (25-75%)

Discussion

The results of the present study showed that supervised 4-week vestibular rehabilitation had similar positive effects on disability and balance in patients with both chronic UVH and chronic BVH.

There are several studies on the efficacy of vestibular rehabilitation in patients with chronic UVH. A randomized controlled study showed that a customized vestibular rehabilitation postively affected disability and balance in patients with chronic UVH (12). In the present study, similar to the abovementioned study, vestibular rehabilitation was effective in improving disability and balance in patients with chronic UVH.

A recently published guideline strongly recommends supervised vestibular physical therapy for individuals with peripheral vestibular hypofunction (1). Another study reported that customized supervised rehabilitation was superior to a home-based exercise program in patients with chronic UVH (13). A retrospective study that evaluated the effectiveness of vestibular rehabilitation on walking ability and balance in patients with chronic UVH reported that multiple interventions by a physical therapist in a rehabilitation program were more beneficial than a single intervention (14). A retrospective study reported that a closely monitored vestibular rehabilitation program was superior to home exercises in patients with vestibular hypofunction (15). In the present study, in patients with chronic vestibular hypofunction, a physiotherapist-supervised rehabilitation program improved balance and disability within 4 weeks. Compared with studies in the literature, a relatively shorter time to reach effectiveness in the present study may be explained by the increased frequency of sessions and the supervision of a physiotherapist. These results indicate that vestibular rehabilitation implemented under the supervision of a physiotherapist can augment effectiveness by improving treatment compliance and motivation. However, comprehensive studies comparing the effectiveness of exercises performed under the supervision of a physiotherapist, home exercises, and combined exercises are needed to support this interpretation.

Vestibular rehabilitation programs are also suitable for patients with peripheral BVH (1). On the other hand, patients with UVH benefit more from vestibular rehabilitation than those with BVH (5,16).

A few studies evaluated the effectiveness of vestibular rehabilitation programs in patients with chronic BVH and UVH. Maslovara et al. (17) reported that a home exercise program improved functionality and confidence in activities in chronic UVH and BVH, being more favorable in chronic UVH. Karapolat et al. (18) reported that a weekly vestibular rehabilitation program for 8 weeks in a vestibular rehabilitation unit and a home exercise program similarly improved disability and balance in patients with unilateral and bilateral vestibular dysfunction. The present study's findings are in agreement with the study by Karapolat et al. (18). Similar positive improvements in disability and balance were observed with 4-week supervised vestibular rehabilitation in both groups, possibly because the rehabilitation program was personally tailored and supervised 3 days a week. The results suggest that increasing the frequency of the supervised vestibular rehabilitation program and supervision of a physiotherapist can yield more positive results in a shorter period.

The retrospective study design, lack of long-term follow-up data, and relatively small sample size are some of the limitations of the present study. On the other hand, the strength of the present study is that it is one of the few studies that comparatively evaluate the effectiveness of supervised vestibular rehabilitation in patients with chronic UVH and BVH.

Conclusion

In conclusion, the results of the present study indicate that the supervised 4-week vestibular rehabilitation program is effective in patients with both chronic UVH and those with chronic BVH and has similar positive effects on disability and balance. Further randomized controlled studies with long-term follow-up in larger patient groups are needed to determine the optimal rehabilitation program for patients with chronic vestibular hypofunction.

Ethics

Ethics Committee Approval: The study protocol was approved by the Ethics Committee of Ankara Bilkent City Hospital (decision no: E2-23-5922, date: 27.12.2023).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Concept: Ö.K., B.B.B., C.Ç., Design: Ö.K., B.B.B., C.Ç., Data Collection or Processing: Ö.K., B.B.B., C.Ç., B.A., Analysis or Interpretation: Ö.K., B.B.B., B.A., Literature Search: Ö.K., B.B.B., Writing: Ö.K., B.B.B., C.Ç., B.A.

Conflict of Interest: No conflict of interest was declared by the authors.

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