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Effect of Dual Task Gaze Stabilization Exercise Along with Brandt-Daroff Exercise on Vertigo Patient

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Abstract: ***Background**: Vertigo, commonly caused by vestibular dysfunction, can significantly impact daily functioning. Benign Paroxysmal Positional Vertigo (BPPV) is a leading cause and is typically managed with Brandt-Daroff exercises. However, patients often continue to experience symptoms, particularly when cognitive aspects such as attention and coordination are not addressed. Dual-task training, which integrates cognitive and physical demands, has demonstrated benefits in neurological rehabilitation but has not been widely explored in the context of vertigo. **Need for Study**: There is an increasing need for rehabilitation strategies that target both vestibular and cognitive components in vertigo patients. Combining gaze stabilization exercises with dual-task training may improve therapeutic outcomes. This study aims to assess the effectiveness of dual-task gaze stabilization exercises alongside Brandt-Daroff exercises in reducing symptoms and improving functional recovery in vertigo patients. **Objective**: The objective was to evaluate the impact of dual-task gaze stabilization exercises combined with Brandt-Daroff exercises on vertigo severity, balance, and overall functional recovery in patients with vestibular disorders. **Methodology**: This case series involved five participants with vertigo, treated over a 4-week period. The intervention included dual-task gaze stabilization exercises along with Brandt-Daroff exercises. Outcome measures included the Dix-Hallpike test, Dizziness Handicap Inventory (DHI), Sitting Balance Scale, Berg Balance Scale, and Visual Analog Scale for Quality of Life with Vertigo. **Results**: Significant improvements were observed across all measures. The DHI score decreased from 26.4 ± 12.75 (pre-test) to 12.8 ± 13.16 (post-test). The Dix-Hallpike test score improved from 15 ± 8.6 (pre-test) to 4.26 ± 4.3 (post-test). Sitting Balance Scale scores increased from 38.2 ± 5.7 (pre-test) to 41 ± 5.05 (post-test), indicating improved balance. The Visual Analog Scale for Quality of Life with Vertigo decreased from 5.34 ± 1.68 (pre-test) to 3.04 ± 0.95 (post-test), reflecting a significant improvement in quality of life. **Conclusion**: The combination of dual-task gaze stabilization exercises and Brandt-Daroff exercises is an effective rehabilitation approach, offering superior outcomes in vertigo patients compared to traditional therapy alone.*

Keywords: Vertigo, Dual-Task Exercise, Gaze Stabilization, Brandt-Daroff Exercise, Vestibular Rehabilitation, Balance, Dizziness

1. Introduction

Vertigo paroxysms brought on by head position changes in the direction of gravity are the hallmark of benign paroxysmal positional vertigo (BPPV) [1]. Degenerated otoconia migrates into the semicircular canals, causing them to become sensitive to head motion, which explains BPPV [2]. BPPV, with a lifetime prevalence of 2.4%, a 1-year prevalence of 1.6%, and a 1-year incidence of 0.6%, is the most prevalent cause of dizziness/vertigo in the globe [3]. 24.1% of hospital visits attributed to vertigo/dizziness are caused by BPPV [4]. With a peak incidence in their sixties and a women-to-men ratio of 2.4:1, BPPV is most frequent among older women [4]. BPPV recurrences are common [5, 6], with a 15–20% yearly recurrence rate [7, 8].

BPPV is a peripheral vestibular system mechanical disorder characterized by recurrent short-lived (less than one minute) episodes of positional vertigo due to calcium carbonate (otoconia) crystals that either [9] stick to the cupula and cause it to become sensitive to gravity (cupulolithasis) [10], or become dislodged from the utricle and travel into the semicircular canals (canalithasis) [11]. With 80–90% of cases, posterior canal BPPV (PC BPPV) is the most frequently affected canal. Horizontal canal BPPV (HC BPPV) is next most common (5–15%), and anterior canal BPPV (AC BPPV) is the least common (1–2%) [12, 13, 14].

The diagnostic criteria for BPPV were established by the Barany Society in the International Classification of Vestibular Disorders (ICVD) [15]. These criteria include the characteristic positional nystagmus elicited by each positional maneuver according to the subtype and affected ear, as well as recurrent attacks of positional vertigo/dizziness provoked by position changes [15]. It is possible to use a pillow beneath the shoulders during the Dix-Hallpike maneuver for PC-BPPV diagnosis rather than extending the patient's neck approximately 30° below the table [16].

This modified method might be helpful for individuals who have trouble relaxing their neck or have limited range of motion in a clinical setting. The direction and relative intensity of the horizontal nystagmus brought on by head-turning when supine is used to identify HC-BPPV. The nystagmus beating toward the lesion side is larger than that toward the healthy side in both the canalolithiatic and cupulolithiatic kinds of HC-BPPV [1]. In patients with HC-BPPV, bedside lateralization accuracy of the afflicted side is adequate when the nystagmus asymmetry is more than 30% [17]. The direction of nystagmus caused by laying down or bending the head (bow and lean test) may help lateralize the affected side when the intensities of nystagmus triggered

during the supine head-rolling test are similar between the directions [18].

While the head-bending nystagmus does the opposite, the lying-down nystagmus primarily beats away from the affected ear in geotropic HC-BPPV but beats toward the affected ear in the apogeotropic form [19]. During the bow-and-lean test, patients with PC-BPPV may exhibit vertical nystagmus [20]. According to a recent study, almost half of the patients with HC-BPPV experience head-shaking nystagmus, which is similar to head-bending nystagmus and aids in lateralizing the affected side [21]. Head-shaking nystagmus is the nystagmus noticed after head oscillation at 2-3 Hz in the horizontal plane for 20 cycles.

When the above-mentioned positional maneuvers cause distinctive nystagmus, this observation serves as the gold standard for diagnosing and classifying BPPV subtype. A small number of studies, however, have examined the use of questionnaires in validating BPPV and classifying the subtypes [22] according to the features (duration, positional triggering, etc.) of the dizziness and the positional shifts that mostly cause it. [23]. A satisfactory sensitivity and specificity for the diagnosis of BPPV were demonstrated by a recent study examining this questionnaire approach [24].

The gold standard for treating BPPV during an attack has been determined to be the canalith repositioning procedure (CRP) [1, 25]. In 80% of cases, a single application of CRPs can result in the remission of symptoms and positional nystagmus [26], and in up to 92% of cases, a repeat application can [27]. A number of CRPs, such as head-shaking and Gufoni's maneuvers for apogeotropic HC-BPPV barbecue rotation and Gufoni's maneuver for geotropic HC-BPPV [27], and Epley and Semont movements for PC-BPPV, have demonstrated effectiveness in randomized controlled trials. A number of movements, such as the reversed Epley's [28] and Yacovino's motions, may be tried for AC-BPPV [60]. Patients with BPPV occasionally suffer from persistent vertigo after CRPs. In these instances, the residual otolithic debris may be located in the distal portion of the PC, and the patients may show positional downbeat nystagmus due to migration of the debris toward the ampulla during the positioning [29]. In this instance, repetition of CRPs may help treat the residual vertigo.

Gaze stability exercises: The treatment tool known as vestibular rehabilitation is predicated on the central principles of. Neuroplasticity, often referred to as substitution, habituation, and adaptation, is what encourages vestibular compensation[30]. The vestibulo-ocular reflex degeneration that lowers the visual VOR gain [31]. is one of the primary effects of the vestibular system's natural aging. Increased retinal slip and hence worse visual acuity during head movement will result from this reduction, which can be retrained using gaze stability exercises[32]. Vestibular adaptation and substitution exercises are types of gaze stability exercises. They enhance the way the vestibular and visual systems interact with head movements and promote equilibrium in situations where there are contradicting sensory inputs [33].

Brandt-Daroff exercises can assist individuals with BPPV cease experiencing dizzy spells. The reasons behind the exercises' effectiveness are unclear. There is evidence to suggest that the exercises assist in moving the loose crystals that initially caused the dizziness. On the other hand, additional data indicates that experiencing dizziness repeatedly lessens its severity. There are most of literature present which depends on the different type of maneuvers which are useful for treatment of vertigo. No studies have evaluated the effects of gaze stabilization exercise along with brandt daroff exercise Hence the goal of this study is to Effect of Dual task Gaze Stabilization exercise along with Brandt-Daroff exercise on Vertigo Patient.

2. Methodology

A case series was conducted on department of Neuro-physiotherapy, Dr. A. P. J Abdul Kalam college of physiotherapy, Loni and Department of ENT, Loni. 5 vertigo patients were assessed between March 2024 to September 2024. Research ethics approval was obtained from Institutional ethical committee of Pravara Institute of medical sciences Loni. four-week treatment period 4 days per week treatment protocol were given to patient.

Inclusion:
1) Age between 18 – 70 years
2) Gender - Both Male and Female
3) Peripheral vertigo
4) Diagnosed By ENT And Medicine Specialist
5) History of tinnitus
6) Difficulty in walking and standing
7) Participants willing to participate.

Exclusion:
1) Other neurological conditions (Parkinson's disease, multiple sclerosis etc.)
2) Hemodynamically unstable.
3) Hearing Deficit
4) Ear infection
5) History of facial and ear pain
6) Hisory of traumatic and non-traumatic cause
7) History of cold and sore throat
8) Recent surgery of eye and ear
9) Participants not willing to participate.

3. Description of Outcome

1) Dizziness Handicap Inventory:
The patient is asked to answer each question as it pertains to dizziness or unsteadiness problems, specifically considering their condition during the last month. Questions are designed to incorporate functional (F), physical (P), and emotional (E) impacts on disability. To each item, the following scores can be assigned: No=0 Sometimes=2 Yes=4 scores: Scores greater than 10 points should be referred to balance specialists for further evaluation. 16-34 Points (mild handicap) 36-52 Points (moderate handicap) 54+ Points (severe handicap) [34]

2) Dix-Hallpike Test:
It is considered to be the gold standard for diagnosing posterior canal BPPVthe procedure was administered as

follows: the patient was seated on the end of the examination table. The head was turned 45- toward the side being tested. The patient was quickly lowered into the supine position so that the head was hanging over the edge of the table reaching an angle of 30- to the horizontal. If symptomatic for BPPV, this maneuver would have reproduced symptoms of vertigo, and the patient's eyes were observed for nystagmus (involuntary rhythmic rotary oscillation of the eyes) in the direction of the affected side. The nystagmus in head down position would have beat toward the undermost ear and lasted for a duration of 10-30 seconds. The patient was then brought up to the seated position, and the eyes were observed for reversal of the nystagmus lasting a shorter duration.[34]

3) Sitting Balance Scale:
11 item ordinal scale test used to assess individuals who are primarily non ambulatory. Able to be used for a variety of conditions, including those who are frail and have chronic conditions. Stopwatch, 2 lb. cuff weight, pen, 12inch ruler, slipper, Physician Desk Reference (PDR) or other stable object 3 to 3.5 inches in height, clipboard, 15"x15"x15" foam 5-point ordinal scale, range 0-4. 0 indicates the lowest level of function and 4 the highest-level function Total score possible: 44 Interpretation: 43.17/44 healthy community dwelling older adults 34.41/44 those with pathologies requiring home health or nursing home residents.

4) Berg Balance Scale for standing balance:
Berg Balance Scale is a performance-based instrument that was originally developed by Berg to assess functional balance in older adults. BBS contains 14 items, each grading on a 5-point Likert scale (0 to 4), representing different levels of difficulty. The BBS total score ranges from 0 to 56, with higher scores indicating a higher level of functional balance. Acceptable levels of intra- (ICC: 0.95) and inter-rater (ICC: 0.93) reliability, with a moderate internal consistency (Cronbach's alpha = 0.62) and high validity, were demonstrated for the Persian version of BBS.[35]

5) Visual Analog Scale-Quality of Life with Vertigo
A total of two questions were asked: (1) the impact of vertigo on daily life and Possible ratings were 0–10 points, with 0 points indicating no effect and 10 points indicating complete inability to partake in normal activity and learning behavior. The two questions were scored separately, and the average score was taken. A score of 0–3 indicated a mild effect, 4–6 indicated a moderate effect, and 7–10 indicated a severe effect. [36]

4. Intervention

It was 4-week protocol for 4 days per week for 45 min dual task gaze stabilization along with 5 min of Brandt-Daroff exercises were perform. After 3rd week Patient should Progress to uneven surface while performing the activities like sit to stand on Swiss ball or walking on the foam mat. Distance of the board and patient should be 20 feet (6 M). Object on the board should be large in size If Patient is having power glasses it should be taken in consideration.

4.1 Dual task Gaze stabilization

While keeping eyes on target, move the head sideways keeping target in the focus. This slowly improve visual acuity and gaze stability. Exercise can be progressed from sitting to standing to walking and involves repeated eye and then head movement between target.

4.1.1 Brandt-Daroff exercises
Start sitting upright on the edge of the bed. Turn your head 45 degrees to the left, or as far as is comfortable. Lie down on your right side. Remain in this position for 30 seconds or until any dizziness has subsided. Sit up and turn head back to center. Turn your head 45 degrees to the right, or as far as is comfortable. Lie down on your left side. Remain in this position for 30 seconds or until any dizziness has subsided. Sit up and turn head back to center. The exercises should be performed in a one set of 5 repetitions. They should be performed three times a day.

Table 1.1: Dual Task gaze stabilization Exercise

Sr. No	Frequency	Time	Type
A. Warm up	10 rep X 2 set	5 min	1) Neck flexion 2) Neck Extension 3) Neck Rotation
B. In sitting	10 Rep X 2 Set	10 min	1) Horizontal and vertical neck movement while watching the black color target which printed on white paper 2) Moving the target neck and eyes should be stabilize on object.
C. Sitting to Standing	10 Rep X 2 Set	5min	1) Sit to stand while solving simple math problems in your head. this gaze should stabilize on the target
D. In walking	10 Rep X 2 Set	10 min	1) Walking 10m with counting the number of cards and watching straight on the black color target which printed on white paper 2) Tandem walking 10m and target placed on the either side of the patient, watching the black color target which printed on white paper 3) Obstacle walking watching straight on the black color target which printed on white paper
E. During activity	10 Rep X 2 Set	10 min	1) Making ring stalk while answering simple question gaze should be stabilize on the target 2)Lifting the wooden block with counting number and gaze should be stabilize on the target.
F. Cool Down	10 Sec Hold X 10 rep X 2 Set	5 Min	1) Neck Stretches 2) Neck Isometrics

4.2 Description of the patient

Table 1.2: Description of symptoms.

S. no	Age	Gender	Diagnosed by ENT specialist	Duration	Symptoms
1	25	M	Yes	15 days	Dizziness with movement Headache Tightness in Trapezius
2	75	F	Yes	2 days	Dizziness Difficulty in maintaining balance
3	41	F	Yes	8 days	Dizziness trigger on position change Headache
4	54	M	Yes	15 days	Dizziness Tinnitus
5	26	M	Yes	5 days	Dizziness Tinnitus

Statistical Analysis

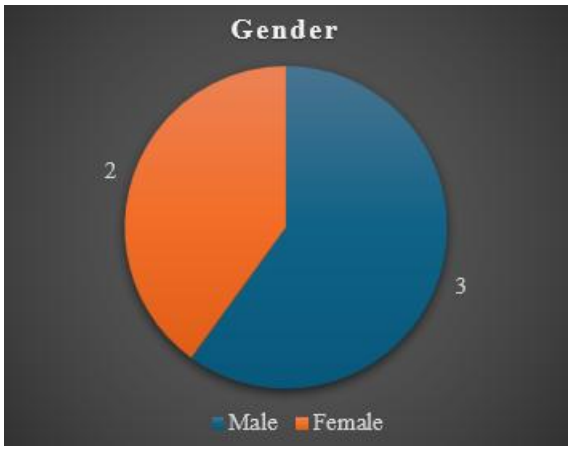
The data obtained from the assessments were analyzed using the IBM SPSS 20.0 software program. Mean (X) and standard deviation (SD) were used for quantitative data, and qualitative data. The data's compliance to normal distribution was evaluated by the parametric test one sample t test. however, The Wilcoxon signed ranks, Mann-Whitney U, and chi square non-parametric tests were used. The paired-t test was used before and after treatment for intra-group comparisons of the collected data. The level of statistical significance was accepted as $p<0.001$

5. Result

A total of 5 individuals participated in this study (Fig. 1). As demonstrated in Table 1.2, the mean of age, height, and weight of the participants were calculated. Mean age and SD of the participant was 44.2±20.94, 2 Female and 3 Male were participated in this study, The average number of days with symptoms were 9 days ±5.87, Mean of Height (154.44±5.06),Weight (60.5±8.54) and BMI was 25.73±2.49.

Table 1.3: Demographic Details

Variable	*Score*
Age	44.2±20.94
Gender	Female =2
Duration	9 days ±5.87
Height	154.44±5.06
Weight	60.5±8.54
BMI	25.73±2.49

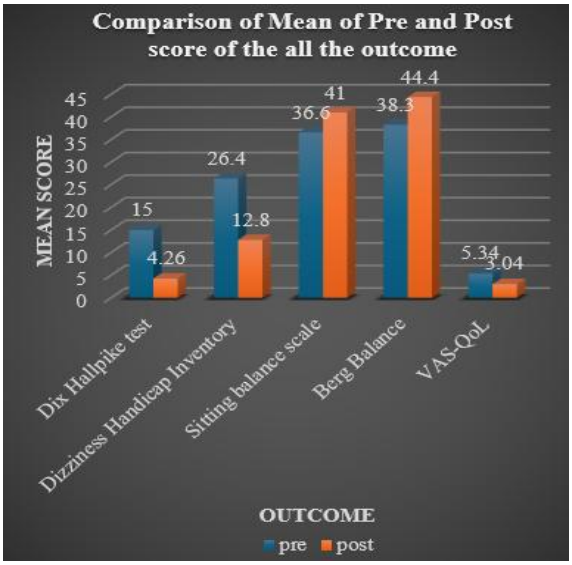


Graph 1.1 Gender wise classification of Male and Female

Table 1.4: Comparison of mean Pre and Post score of the all the outcome

Outcome	*Pre-Score (Mean ± SD)*	*Post Score (Mean ± SD)*	*P value*
Dix-Hallpike Test	15 ±8.6	4.26 ±4.3	0.009
Dizziness Handicap Inventory	26.4 ±12.75	12.8 ±13.16	<0.0001
Sitting Balance Scale	36.6±7.26	41±5.05	0.008
Berg Balance scale	38.2±5.7	44.4±4.77	0.0001
Visual Analog Scale-Quality of Life with Vertigo	5.34±1.68	3.04±0.95	0.009

Table 1.3 shows the pre and posttest values of Dix Hallpike test, Dizziness Handicap Inventory, Sitting Balance scale, Berg Balance scale and Visual Analog Scale-Quality of Life with Vertigo. Based on the statistical analysis the result of the study shows that there is statistically significant difference between pretest and posttest values. P value <0.001.



Graph 1.2: Comparison of Mean of Pre and Post score of the all the outcome

Dizziness Handicap mean Score for pretest was 26.4 ±12.75 and post test score mean was reduced to 12.8 ±13.16 which shows significant improvement. Dix Hallpike test mean score for pretest was 15 ±8.6 and post test score mean was reduced to 4.26 ±4.3 which shows significant improvement.

Sitting Balance Scale mean score for pretest was 38.2±5.7 and post test score mean was increased to 41±5.05 which shows the patient sitting balance were improved. Visual Analog Scale-Quality of Life with Vertigo score for pretest was 5.34±1.68 and post test score mean was reduced to 3.04±0.95 which shows significant improvement in the Visual Analog Scale-Quality of Life with Vertigo.

6. Discussion

Although vestibular rehabilitation has been accepted as an effective treatment method in patients with dizziness, little is known on whether some vestibular rehabilitation approaches are more effective than others. This study aimed the effect of Dual task Gaze Stabilization exercise along with Brandt-Daroff exercise on Vertigo Patient.

The current study has demonstrated the statistical significance of improvements within pre and post score for quality of life and vertigo symptoms as well as Dix Hallpike Test, Dizziness Handicap Inventory, Sitting Balance Scale, Berg balance Scale and Visual Analog Scale-Quality of Life with Vertigo.

In our study, mean age and SD of the participant was 44.2±20.94, 2 Female and 3 Male were participated in this study, The average number of days with symptoms were 9 days ±5.87, Mean of Height (154.44±5.06), Weight (60.5±8.54) and BMI was 25.73±2.49.

One study's gender distribution found that women made up 65% of the population, whereas other research indicated that the ratio of women to men was higher, at 75–85%.(37)

In our study, the meaning of dizziness handicap the pre-test mean score was 26.4 ±12.75, while the post-test mean score decreased to 12.8 ±13.16, indicating a notable improvement. The Dix Hallpike test mean score improved significantly from 15 ±8.6 on the pre-test to 4.26 ±4.3 on the post-test. The patient's sitting balance improved, as evidenced by the Sitting Balance Scale mean score rising from 38.2±5.7 on the pre-test to 41±5.05 on the post-test. Prior to the test, the Visual Analog Scale-Quality of Life with Vertigo score was 5.34±1.68, and after the test, the mean score dropped to 3.04±0.95, indicating a considerable improvement.

The Brandt-Daroff exercise is a widely used, evidence-based treatment for benign paroxysmal positional vertigo (BPPV), designed to reduce dizziness and improve vestibular function through habituation and adaptation mechanisms. By utilizing a series of positional maneuvers, these exercises help patients regain stability by reconditioning the vestibular system. However, while effective, Brandt-Daroff exercises primarily target the physical aspects of vertigo, such as alleviating symptoms triggered by head movements.

Dual-task gaze stabilization exercises, on the other hand, introduce a cognitive element by requiring patients to maintain visual fixation on a target while performing head movements. This type of exercise challenges both the vestibular system and the brain's ability to process and integrate sensory input, which has been shown to improve neural plasticity and enhance both motor and cognitive functions. The integration of cognitive load through dual tasks helps stimulate neural pathways involved in balance control, potentially leading to quicker recovery and better functional outcomes compared to traditional vestibular rehabilitation alone.

Repositioning maneuvers are the recommended therapy methods. Brandt-Daroff home exercises are the recommended treatment option for patients for whom repositioning maneuvers are not feasible. Repositioning movements in BPPV have been reported to have success rates ranging from 80 to 100 percent.

It has been suggested that canalith repositioning procedures could be successfully substituted with Brandt-Daroff exercises. 48 patients were randomly assigned to either the Epley maneuver, the Semont maneuver, or the Brandt-Daroff exercises by Karanja et al. (19). Patients were observed for three months after being assessed in the second week. In the Epley group, the healing rate was 87%; in the Semont group, it was 75%; and in the Brandt-Daroff group, it was 56%.

Although previous studies have shown controversial results for Brandt-Daroff home exercises, they can be administered as primary treatment options for patients in whom the canalith repositioning maneuver cannot be performed (e.g., cervical problems or carotid stenosis). Additionally, Brandt-Daroff exercise along with dual task gaze stabilization exercises are applied to patients with BPPV, it shows significant improvement in the patients, and patients can be treated at home alone. The results of this study align with current literature supporting the synergy between cognitive and vestibular rehabilitation. Research suggests that engaging both sensory and cognitive domains during therapy can enhance balance and functional mobility. In particular, dual-task training has been shown to improve postural control in individuals with vestibular disorders, especially in those who experience both physical and cognitive deficits. This underscores the importance of considering not just the physical, but also the cognitive aspects of vertigo rehabilitation.

7. Conclusion

According to the study's findings, individuals with vertigo benefit greatly from the combination of Dual Task Gaze Stabilization exercises and Brandt-Daroff workouts in terms of improved balance, decreased vertigo symptoms, and improved total functional recovery. Beyond the conventional Brandt-Daroff exercises alone, the dual-task component, which involves both visual stabilization and cognitive processing, seems to provide extra therapeutic advantages. Brandt-Daroff exercises and Dual Task Gaze Stabilization exercises seem to work well together as a rehabilitation method for vertigo sufferers. This multimodal strategy may hasten recovery, enhance functional outcomes, and lower the risk of falls by addressing the cognitive and physical aspects of vertigo. Therefore, adding dual-task training to therapeutic

practice may provide a more thorough, multifaceted remedy for vertigo sufferers, especially those with complicated deficiency.

Clinical Implications:
The combination of Brandt-Daroff and gaze stabilization exercises provides a multifaceted approach to vertigo management. Not only does it address the vestibular system's physical dysfunction, but it also enhances the brain's ability to process sensory information, improving overall stability and reducing dizziness. The dual-task paradigm may be particularly beneficial in cases of chronic or refractory vertigo, where traditional vestibular exercises alone are insufficient. This integrated approach could also expedite recovery, reduce fall risk, and improve quality of life for patients.

8. Limitations and Future Directions

While the findings are promising, this study is not without limitations. The sample size was relatively small, which may limit the generalizability of the results. Additionally, the duration of the intervention was relatively short, and long-term follow-up is necessary to determine the sustained effectiveness of this combined approach. Further research with larger, more diverse patient populations, along with longitudinal studies, is needed to validate the findings and explore the mechanisms underlying the observed improvements. It would also be beneficial to compare the combined intervention with other forms of vestibular rehabilitation, such as vestibular habituation training or dynamic balance exercises, to determine which combination offers the most substantial benefit.

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