RESEAERCH PAPER

Effect of Vestibular Rehabilitation Therapy on Balance and Dizziness in Patients with Vestibular Disorders

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ABSTRACT

Background: The inner ear and the central connections that process its input (the vestibular system) are the organs that maintain balance, gaze stability and spatial orientation. Usually, the problems associated with vestibular dysfunction include dizziness, postural instability, and decreased functional independence of daily living. VRT is an exercise-based therapy that aims to induce central vestibular compensation and is an effective treatment for vestibular disorders.

Objective: To compare the effectiveness of VRT and conventional physiotherapy in improving balance and reducing dizziness-related disability in individuals with vestibular disorders.

Methods: 30 patients with vestibular disorders were randomly divided into 2 groups; 15 patients each in a VRT group and a conventional physiotherapy group. Supervised treatment was given for 6 weeks to both groups. The Berg Balance Scale (BBS) and the Dizziness Handicap Inventory (DHI) were administered at baseline and post intervention to assess balance and dizziness related disability.

Results: VRT is superior to conventional physiotherapy in enhancing balance and reducing disability due to dizziness and is a useful targeted rehabilitative treatment for people with vestibular disorders.

Keywords: Vestibular Disorders, Vestibular Rehabilitation Therapy, Balance, Dizziness, Physiotherapy.

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INTRODUCTION

The vestibular system consists of the inner ear's semicircular canals and otolithic organs, along with the central neural pathways that process this input, and supplies the major sensory input for maintaining balance, keeping the eyes stable during head motion, and perception of the position of the body in space (1). These symptoms are frequently seen when this system is disrupted either peripherally or centrally, and include vertigo, imbalance, oscillopsia and impaired safety in daily activities.

There are multiple mechanisms for peripheral vestibular disorders. One of the more common causes of vertigo is benign Paroxysmal Positional Vertigo (BPPV) which is caused by the displacement of otoconia within the semicircular canals, and is a condition that is accompanied by brief, position-induced episodes of vertigo (2). Vestibular neuritis, believed to be a consequence of a viral attack on the vestibular nerve, results in an acute, persistent period of vertigo plus nausea and postural instability (3). Endolymphatic hydrops is the cause of Ménière's disease, which is characterized by recurrent vertigo, fluctuating hearing loss and tinnitus (4). Central lesions, such as cerebellar and brainstem damage, also may affect the processing of the vestibular, visual and somatosensory cues needed for postural control (5).

It is a functional consequence irrespective of cause, the mismatch between the signals generated by head and body movement and the signals expected by the central nervous system and resulting conflict between these signals causing dizziness and unsteadiness. The central nervous system has to reweight and adjust to the

changed or imbalanced vestibular signal and this process is called vestibular compensation; the recovery from this state is largely dependent on vestibular compensation (6).

Vestibular Rehabilitation Therapy (VRT) is an exercise-based therapy aimed at actively encouraging this compensation process. Common VRT protocols include gaze-stabilization exercises (re-training the VOR), habituation exercises (provocation reduction through repeated, controlled exposure to movement), and balance-retraining exercises (sensory reweighting and functional postural control). The American Physical Therapy Association (APTA) developed clinical practice guidelines based on systematic review of a large randomized and observational evidence base that strongly supports VRT for unilateral and bilateral peripheral vestibular hypofunction, and that minimal harm is associated with VRT (7,8). Other systematic reviews, such as a Cochrane review, have drawn a comparable conclusion, finding moderate to strong evidence for the use of VRT in unilateral peripheral vestibular dysfunction (9).

Although the benefits of VRT compared to no treatment or placebo exercise are well supported internationally, the evidence is more limited when compared to conventional physiotherapy (which generally focuses on generic balance and gait training as opposed to vestibular-specific exercises) and this is especially limited in Indian clinical settings. In a context of high prevalence and functional impairment of Vestibular Disorders, more comparative evidence is clinically relevant and useful, given the ease of access to exercise-based rehabilitation. The present study was therefore designed to assess the effectiveness of VRT as compared to physiotherapy in improving balance and dizziness-related handicap in patients with vestibular disorders, using the Berg Balance Scale and the Dizziness Handicap Inventory as outcome measures.

METHODS

Study Design

This study was designed as a pre–post interventional trial to evaluate the effectiveness of Vestibular Rehabilitation Therapy (VRT) on balance and dizziness in individuals with vestibular disorders.

Study Setting and Duration

The study was conducted in the Department of Neurological Physiotherapy, Pacific College of Physiotherapy, Pacific Medical University, Udaipur, Rajasthan, India, over a period of 6 weeks.

Participants

Thirty participants diagnosed with vestibular disorders were enrolled according to the inclusion and exclusion criteria below and randomly allocated into two groups of 15 each (Group A: VRT; Group B: conventional physiotherapy).

Inclusion Criteria

- Adults aged 35–65 years
- Patients diagnosed with vestibular dysfunction
- Presence of dizziness and balance impairment
- Ability to understand and follow simple verbal instructions

Exclusion Criteria

- Severe neurological disorders
- Severe visual impairment
- Musculoskeletal conditions affecting balance
- Cognitive impairment affecting participation

Intervention Protocol

All participants received supervised physiotherapy sessions of approximately 30 minutes, five days per week, for six weeks.

Vestibular Rehabilitation Therapy (Group A)- The VRT program was designed to improve gaze stability, balance control, and vestibular adaptation, and included:

- Gaze stabilization exercises
- Eye–head coordination exercises
- Habituation exercises
- Balance retraining
- Walking with head movements

Conventional Physiotherapy (Group B)- Conventional rehabilitation aimed to improve postural stability and functional balance, and included:

- Static balance exercises
- Dynamic balance training
- Weight-shifting activities
- Gait training
- Postural correction exercises

Outcome Measures

Balance was assessed using the Berg Balance Scale (BBS), a 14-item performance measure of static and

dynamic balance validated for use in populations at risk of falls (10).

Dizziness-related handicap was assessed using the Dizziness Handicap Inventory (DHI), a 25-item self-report questionnaire evaluating the functional, emotional, and physical impact of dizziness (11). Both measures were administered at baseline (pre-intervention) and after six weeks (post-intervention).

Statistical Analysis

Within-group pre- and post-intervention scores were compared using the paired t-test. A P value < 0.05 was considered statistically significant.

Ethical Considerations

Written informed consent was obtained from all participants prior to enrolment. Patient confidentiality was maintained throughout the study, and all procedures were conducted in accordance with institutional ethical guidelines and the principles of the Declaration of Helsinki.

RESULTS

A total of 30 participants (Group A, n = 15; Group B, n = 15) completed the six-week intervention. Baseline characteristics were comparable between the two groups (Table 1).

Table 1: Baseline characteristics of participants

Variable	Group A (Mean ± SD)	Group B (Mean ± SD)
Age (years)	48.3 ± 7.5	47.9 ± 6.8
Male, n	9	8
Female, n	6	7

At baseline, DHI and BBS scores did not differ significantly between groups. Following six weeks of intervention, both groups showed significant within-group improvement (P < 0.05), but the magnitude of improvement was significantly greater in Group A.

Table 2: Comparison of Dizziness Handicap Inventory (DHI) scores

Outcome Measure	Pre-treatment	Post-treatment
VRT – DHI score	62.4 ± 6.2	28.3 ± 5.1
Conventional – DHI score	61.8 ± 5.9	40.6 ± 5.7

Table 3: Comparison of Berg Balance Scale (BBS) scores

Outcome Measure	Pre-treatment	Post-treatment
VRT – BBS score	38.5 ± 4.6	50.2 ± 3.8
Conventional – BBS score	39.1 ± 4.2	45.4 ± 4.1

Mean DHI scores in Group A fell from 62.4 ± 6.2 to 28.3 ± 5.1, compared with 61.8 ± 5.9 to 40.6 ± 5.7 in Group B (Table 2). Mean BBS scores in Group A rose from 38.5 ± 4.6 to 50.2 ± 3.8, compared with 39.1 ± 4.2 to 45.4 ± 4.1 in Group B (Table 3). These results suggest that both interventions resulted in functional improvement, but VRT was significantly more effective than conventional physiotherapy in reducing dizziness-related handicap and improving balance.

DISCUSSION

The purpose of this study was to analyze the differences in the effects of Vestibular Rehabilitation Therapy (VRT) and conventional physiotherapy on balance and dizziness in patients with vestibular disorders. The two groups were well-balanced at baseline in terms of age (48.3 ± 7.5 years for Group A and 47.9 ± 6.8 years for Group B) and pre-treatment DHI and BBS scores, thus allowing a valid within- and between-groups comparison of treatment effect.

This was the observation of both groups; after 6 weeks of intervention, the groups demonstrated statistically significant gains, indicating that any well-structured,

supervised, balance intervention resulted in some functional benefit (12). But the increase in performance was significantly greater in some groups than in others. The mean DHI score of Group A decreased by around 34 points, whilst Group B decreased by around 21 points, suggesting a significant drop in the self-perception of a handicap due to dizziness after VRT. As a result, the mean BBS score in Group A increased about 12 points from baseline, while the score in Group B increased about 6 points. This means that the functional balance increased more in Group A than in Group B.

These results are similar to those previously reported for dynamic visual acuity, gaze stability and balance after structured vestibular exercise programs in patients with vestibular hypofunction (13,14). The advantage seen with VRT over generic balance training in the present study may be because VRT is a mechanism-based training, as physiotherapy exercises commonly target balance and walking without focusing on the source of the dysfunction, the vestibulo-ocular reflex. The exercises in VRT target the source of the dysfunction and focus on the adaptive reweighting of sensory input, habituation of provocative head movements, compared to walking and balance exercises.

The DHI and BBS are clinical outcome measures used in this study that have been well-validated for assessing treatment response in dizzy and balance-disordered patients, and are recommended as core outcome measures in this population (16). The two measures together were able to assess both the patient reported functional and emotional burden of dizziness and an objective performance-based measure of balance, enhancing confidence in the consistency of the observed treatment effect across both measures of dizziness.

Previous reports have demonstrated the superior effects of vestibular-specific exercise programs over general rehabilitation. Early programmatic descriptions of VRT found that the effect of the program on improving performance was larger and more consistent than that of passive or non-specific interventions (17), which was later supported by mechanistic and clinical reviews of the central adaptive processes underlying the effect of VRT (18). Similarly, a series of small controlled trials in patients with bilateral vestibular hypofunction (BVHF) has shown that structured vestibular exercise has measurable effects on improving gait speed and postural stability compared to a non-specific isometric-exercise control group (19), and recent systematic reviews have shown similar relative benefits of structured vestibular exercise (20).

Vestibulospinal and vestibulo-ocular pathways are central mechanisms involved in the reorganisation that occurs in the VRT group with repeated graded exposures to head and body movement, which brings about a restoration of the correspondence between expected and actual sensory feedback, thus explaining the greater improvement observed in the VRT group mechanically (21). Experimental evidence suggests that active, exercise-based stimulation can stimulate this central compensatory process more rapidly than spontaneous recovery (22) and there is evidence that some types of vestibular exercise lead to a more complete central vestibulospinally mediated compensation than non-specific activity. Sensory reweighting is an important mechanism for recovery of functional postural control (23) and involves the progressive nature of their use of visual and somatosensory cues to replace diminished vestibular input as compensation progresses.

The results of this study support the use of vestibular exercises as a first-line treatment for vestibular-specific rehabilitation over generic balance exercises alone for patients with a known diagnosis of a vestibular disorder, as there was a greater reduction in dizziness handicap and a greater improvement in balance performance during VRT than during conventional physiotherapy. This is especially true in resource-limited clinical settings, where VRT protocols do not require complicated equipment and can be delivered at home without supervision for continued benefit and adherence after the initial supervision.

There are some limitations of this study. The number of samples was small (n = 30), there was no longer-term outcome assessment and blinding of outcome assessors was not reported. These findings would be strengthened if they were obtained in larger, multiple centre trials with longer follow-up and blinded evaluation of outcomes.

Conclusion

VRT (Vestibular Rehabilitation Therapy) was effective in improving balance and significantly reducing dizziness-related handicap, compared to conventional physiotherapy in the patients with vestibular disorders, within a 6 weeks intervention period. The results are in favour of introducing vestibular-specific exercise programmes into the physiotherapeutic treatment of patients with vestibular disorders, as opposed to plain balance training.

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Conflict of Interest Statement

The authors declare that they have no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contribution Statement

Conceptualization: Deepak Lohar, Jafar Khan. Investigation: Nishita Shaurya. Methodology: Nishita Shaurya, Deepak Lohar. Formal analysis: Nishita Shaurya, Deepak Lohar. Supervision: Deepak Lohar, Jafar Khan. Writing – original draft: Nishita Shaurya. Writing – review & editing: Nishita Shaurya, Deepak Lohar, Jafar Khan. All authors approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Ethics Approval

This study was conducted in accordance with institutional ethical guidelines and the principles of the Declaration of Helsinki. [Institutional Ethics Committee name and approval number to be inserted by the authors prior to submission.]

Informed Consent

Written informed consent was obtained from all individual participants included in the study.

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