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Efficiency of Physiotherapy Interventions in the Treatment of Dizziness & Balance Disorders: A Narrative Review

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ABSTRACT

Vestibular disorders including conditions such as benign paroxysmal positional vertigo (BPPV), vestibular neuritis and Meniere's disease, bilateral vestibular hypofunction, central vestibular disorders are common causes of vertigo, dizziness and imbalance. These disorders can significantly impact an individual's quality of life leading to functional impairment and increased risk of falls. Vestibular rehabilitation aims to promote central nervous system adaptation and compensation mechanism to decrease symptoms and improve functional outcomes. Physiotherapy interventions with Vestibular rehabilitation programs typically include a combination of gaze stabilization exercises, habituation exercises, balance training, and manual therapy techniques are tailored to address specific vestibular impairments. Despite the widespread adoption of Vestibular rehabilitation in clinical practice, the evidence supporting the effectiveness of physiotherapy interventions in vestibular rehabilitation remains varied. This review will provide insights into the effectiveness of physiotherapy interventions protocols in the treatment of vestibular and balance disorders. Additionally, it will explore factors influencing treatment outcomes such as patient characteristics, treatment adherence and duration of intervention.

Keywords: "peripheral vestibular rehabilitation", "vestibular rehabilitation", "habituation exercises", "gaze stabilization exercises", "balance training", "dizziness disorder" "balance disorder".

INTRODUCTION

Dizziness is a common complaint reported in primary care practice and results in more than 6 million visits to physician offices per year in the United States alone. Although dizziness can be caused by a variety of medical conditions, it is estimated that 50% of cases are due to vestibular dysfunction. Many patients with a complaint of dizziness are referred to physical therapy for treatment to relieve the dizziness and symptoms associated with disequilibrium [1]. Balance disorders are the main cause of falls in the elderly due to vestibular disorders. This further results in disability in them due to fractures, head injuries, soft tissue injuries. Vestibular disorders occur due to Benign paroxysmal positional vertigo (BPPV), vestibular neuritis and Meniere's disease, bilateral vestibular hypofunction, central vestibular disorder. BPPV is characterized by short duration of vertigo activated by a change in the position of an individual's head with respect to gravity

with symptoms typically lasting less than 1 minute (i.e., the nystagmus fatigues with repeated stimulation of the semicircular canal). BPPV is the most widely recognized vestibular disorder representing one-third of vestibular diagnoses in the general population [2]. In BPPV, calcium carbonate particles (otoconia) become displaced into the canals from the otolith organs causing changes in the fluid dynamics of the canals. Meniere's disease is the commonest cause of vertigo of otologic origin proposed to be due to dilation and sporadic rupture of the endolymphatic compartment of the inner ear. It is clinically characterized by ipsilateral fluctuating low-frequency hearing loss, tinnitus, aural fullness, and episodic vertigo. Endolymph hydrops is thought to be the pathologic basis of Meniere's disease either because of an excessive production or a minimum absorption of the endolymph [3]. The pressure within the endolymphatic compartment increases and causes sporadic rupturing of the membrane separating the endolymphatic compartment of the inner ear.

Vestibular rehabilitation (VR) is effective form of specialized physiotherapy technique which has emerged as a treatment approach for managing peripheral vestibular disorders. Vestibular rehabilitation exercises focus on gaze stability and gait stability and includes both static and dynamic balance exercises. Vestibular rehabilitation is described predominantly as a movement and exercise-based approach that includes adaptation, substitution (including postural control strategies) and habituation. Unilateral peripheral vestibular hypofunction is a disorder that affects one side of the vestibular system and excludes vestibular dysfunction related to the brain [4].

One should separate two different groups of indications that correspond to two different strategies of rehabilitation. The repositioning maneuvers aim to treat the misplacement of otoliths in a scenario of benign positional paroxysmal vertigo (BPPV) [5]. In addition, the early the rehabilitation, the faster the recovery because the immediate post-onset period is highly sensitive to somatosensory and visual inputs and stimulations. Bilateral vestibular loss (BVL) situation is more challenging and requires a thorough evaluation to assess for the remaining response of the vestibules. Complete BVL are due to vestibulotoxic antibiotics, autoimmune inner ear diseases, bilateral Menière's disease, meningitis and rarely bilateral temporal bone fracture. Clinical diagnosis of BVL is based on the result of three simple bedside tests: a positive head impulse test, reduced dynamic visual acuity and a positive Romberg test on foam rubber [6].

This review will explore various physiotherapy interventions commonly employed in VR programs including:

- Gaze stabilization exercises:
- Habituation exercises: Intended to desensitize the vestibular system to motion stimuli, reducing symptoms of vertigo and dizziness.
- Balance training: Targeting deficits in postural control and stability to minimize the risk of fall and improve functional mobility.
- Manual therapy technique: Includes canalith repositioning maneuvers for BPPV and cervical spine mobilization for cervicogenic dizziness.

Overall, this narrative review aims to contribute to the ongoing optimization of vestibular rehabilitation practices by providing evidence-based recommendations for the selection and implementation of physiotherapy interventions in the management of vestibular disorders. Vestibular physical therapy has become an accepted approach in the management of patients with balance disorders manifesting as dizziness and disequilibrium.

MATERIALS & METHODS

Study design

The design of the current study is a narrative review. The design was

chosen to give an overview of previous research about the Peripheral Vestibular rehabilitation of dizziness and balance disorder.

Data collection

An online literature search was conducted between May 8th, 2022 and June 10th, 2024 using, PubMed, PMC, Google Scholar. The keywords were as follows: "peripheral vestibular rehabilitation" OR "vestibular rehabilitation", OR "habituation exercises", OR "gaze stabilization exercises", OR "balance training", OR "dizziness disorder" AND "vertigo". Searches on PubMed and Google Scholar were done by employing the Boolean Logic (AND, OR and NOT) to generate different combinations of search strings. After the identification of relevant studies duplicates were removed. Manual searches of reference list of included articles were undertaken to search for possible studies not captured by the electronic searches. Then, the title and abstract were screened for eligibility. Lastly, the full text papers were assessed to verify whether the study met the inclusion criteria.

Inclusion criteria

- Vertigo patients as participants
- Studies having effect of any physiotherapy interventions
- Full text available
- Published in English
- Clinical trials
- Observational studies

Exclusion criteria

- Not having vertigo patients
- Case studies
- Abstracts
- Literature reviews
- Systematic reviews

RESULTS

S. no	Author	Objective	Participants	Outcome Measures	Intervention	Duration	Result
1	Laura Power, et. al (2019) (Observational study)	Treatment in Benign Paroxysal Positional Vertigo	n=314	DHP or SRT	Canalith repositioning manoeuvres (CRP) for posterior canal (PC) or horizontal canal (HC) BPPV depending on the canal and variant of BPPV.	42 days	91% of PC BPPV case were effectively treated in 2 manoeuvres or less, 88% of HC BPPV presentations were effectively managed with 2 treatments. Bilateral PC, multiple canal or canal conversions required a greater number of treatments.
2	J Y Jung, et. al (2009)	Effect of VR on dizziness in the elderly	n=240 >70 years Patients older than 70 years with complaints of dizziness and/or	Otolaryngologic examination, ear-nose-throat examination including otoscopy, cranial	Vestibular rehabilitation Techniques	3 months	Improvement in dizziness in the VRT group was significantly higher than in the non-VRT group by the verbal

			disequilibrium	nerves, Romberg test; and tandem walking test, electronystagmography, rotating chair testing and posturography,MRI, Verbal analogue scale, Activities specific Balance Confidence Questionnaire			analogue scale and Activities-specific Balance Confidence scale obtained at 3 weeks and at 3 months after the initiation of VRT.
3	Eva Ekvall Hansson, et. al (2008)	To investigate whether vestibular rehabilitation can improve balance, reduce self-perceived handicap because of dizziness	n=276 >65 years	Balance measures: (Tandem stance with eyes open and eyes closed, standing one leg with eyes open and eyes closed for both sides, walking in figure of eight, walking heel to toe on a 5-m long line, The Dizziness Handicap Inventory	Group sessions in a physiotherapy centre, for approximately 50 min, twice a week for 9 weeks. 10-min warm-up phase. The patients performed each exercise for 2 min and then went on to the next, completing two laps in the circuit. Exercises were: Standing on foam and turning the head from side to side, Walking on slope and turning head from side to side, standing on trampoline, slightly flexing the knees and turning the head from side to side, standing on	12 months	Stastically significant differences were found in one static balance measure and one dynamic balance measure The intervention group had improved in five of the balance measures and deteriorated in one, whereas the control group had deteriorated in four of the balance measures and had no change in the other two. Vestibular rehabilitation can improve balance in elderly patients.

					sport mat, walking on the spot and turning the head from side to side, sitting on bobath ball, feet on foam and bouncing slightly while turning the head from side to side.		
4	Adam W.A. Geraghty, et. al (2017)	Internet-Based VR for older adults with chronic dizziness	n=296 >50 years	VSS-SF (Vertigo symptom scale-short form, Dizziness Handicap Inventory, Hospital Anxiety and Depression Scale	Cognitive behavioral coping strategies such as relaxation, breathing techniques, and cognitive restructuring were integrated with the vestibular rehabilitation material. Vestibular rehabilitation consists of specific exercises including nodding and shaking the head.	6 months	Intervention group experienced less dizziness and disability related to it.
5	Jennifer L. Cowand, et. al (1998)	Efficacy of VR	n=37 mean age = 69.8		Vestibular rehabilitation.	2-38 weeks	The Wilcoxon two-sample test did not identify any significant difference in improvement between patients who were compliant with their home exercise program and those who were not.
6	Richard A.Clenda niel, et. al (2010)	The effects of habituation and gaze stability exercises in the treatment	n=7	DVA test was performed under both active (self-generated head movements)	6-week exercise intervention after random assignment to either habituation exercises or	6 weeks	Gaze stabilization and habituation exercises have previously been shown to decrease symptoms of

		of unilateral vestibular hypofunction		and passive (examiner-generated head movements) conditions.	gaze stability (GS) adaptation exercises.		dizziness and increase function in individuals with vestibular disorders.
7	Natalia Aquaroni Ricci, et. al (2016)	To compare the effects of vestibular rehabilitation protocols on balance control in elderly with dizziness	n=82	otolaryngologic evaluation, flexibility, cognition, sensory interaction and muscle strength	Vestibular rehabilitation		The between-group differences for Sensorial Romberg Eyes Closed (4.27 secs) and Unipedal Left Leg Eyes Open (4.08 secs) were significant after treatment, favoring the Multimodal protocol.

DISCUSSION

In this review, a total of 1252 participants from 7 clinical trials were evaluated. The outcome measures used DHP or SRT, examination including otoscopy, cranial nerves, Romberg test; and tandem walking test, electronystamography, rotating chair testing and posturography, MRI, Verbal analogue scale, Activities specific Balance Confidence Questionnaire, Balance measures: Tandem stance with eyes open and eyes closed, standing one leg with eyes open and eyes closed for both sides, walking in figure of eight, walking heel to toe on a 5-m long line, The Dizziness Handicap Inventory, VSS-SF (Vertigo symptom scale-short form), Dizziness Handicap Inventory, Hospital Anxiety and Depression Scale, DVA test was performed under both active (self-generated head movements) and passive (examiner-generated head movements), otolaryngologic evaluation, flexibility, cognition, sensory interaction and muscle strength. Physiotherapy vestibular rehabilitation exercises focus on gaze stability and gait stability and includes both static and dynamic balance exercises and manual therapy canal repositioning maneuvers and internet based vestibular rehabilitation reduces the dizziness and improved balance. There is improvement in vestibular symptoms when patients were complaint with the exercises [7]. There is varying length of treatment protocols that were followed in treating patients with vestibular disorders.

Adaptation exercises or vestibulo-ocular reflex stimulation exercises:

These exercises are designed to improve the gain of the VOR, which maintains stable gaze and visual focus during active and passive head motion. Exercises consist of performing head movements while keeping a target in focus. For example, a patient is asked to look at a target in front of him and move his head side to side while keeping the target in focus. The exercises should be gradually enhanced by pushing the speed to a level just before the target falls off focus. As function improves, the exercise can be advanced to moving the card opposite to head movement. Moving the arm and head in opposite directions forces a doubling of the amplitude needed for the eyes to stay on target. It also takes quite a bit of coordination to perform this combination exercise, making the exercises difficult to perform for many patients. Because adaptation is so precise, the exercise must be performed in various positions (i.e.,

sitting, standing, lying, walking) and at various distances and speeds [8].

Substitution exercises:

The aim is to improve the visual and somatosensory cues and inputs, using exercises that challenge balance without vision, with disturbed vision, or on uneven surfaces. These balance exercises can enhance the use of the vestibular input and should be performed to challenge both static and dynamic balance. A patient may be instructed to stand with his feet together on a firm surface and then progress to a compliant surface. Exercises can be carried out with the eyes closed or while moving the arms or catching a ball. However, in case of severe damage to the vestibular function, exercises without visual inputs are not indicated because increasing visual and proprioceptive inputs is mandatory [9].

Habituation exercises:

Gaze stabilization and habituation exercises have previously been shown to decrease symptoms of dizziness and increase function in individuals with vestibular disorders [10]. These exercises aimed to get through the repetition of stimulus, an increase in the thresholds of the clinical response. Habituation exercises are the focus of vestibular rehabilitation with respect to BPPV with particle repositioning maneuvers such as the Epley's or Semont's. It has been shown that combining positional maneuvers with vestibular rehabilitation improve outcomes. Chang and Chern showed that additional vestibular rehabilitation exercise training that emphasized vestibular stimulation (repeated head movements to habituate vestibular responses) showed improved ability and functional gait performance in patients who had already undergone positional maneuvers [11]. The experimental group demonstrated decreased sway velocity with eyes closed and single-leg stance with eyes closed after four weeks of treatment. The habituation exercises are clearly illustrated by Brandt and Daroff protocol [12]. It is crucial to identify the position that induces a clinical signs and to repeat them with the therapist at increasing speeds.

Virtual Reality:

Recent advances in the ongoing research of vestibular rehabilitation have incorporated virtual reality into the traditional sessions and documented improved posturography, vertigo, and mental health scores. In 2007, the Cochrane review deemed that evidence was sufficient to support the addition of simulator-based activities to vestibular rehabilitation programs. NASA has used this virtual reality technology since 2005 and taken it one step further. They hope to train the vestibular system to decrease motion sickness, increase function in disorienting environments and speed recovery when returning to gravity and solid ground. In 2012, Pavlou and coll. demonstrated using specific questionnaire that Exposure to dynamic virtual environments was a useful adjunct to vestibular rehabilitation programs for patients with peripheral vestibular disorders. The use of virtual reality is definitely exciting and programs using the NintendoTMWiiTM platform have been tested with success for the improvement of the dizzy patient [13].

Physical Therapy for Menier's disease:

Persons with Meniere's disease typically present with vertigo, tinnitus, and aural fullness. The management of Meniere's disease has been challenging because of recurrent episodes of vertigo. Vestibular exercises have been used to improve quality of life in people with Meniere's disease. A virtual reality-based balance rehabilitation program was used recently in people with Meniere's disease to assess its efficacy in improving quality of life, decreasing dizziness spells, and improving postural stability [14]. The Balance Rehabilitation Unit virtual reality platform was used during 12 sessions (twice a week). Findings revealed significant improvements in postural control and perceived dizziness handicap in the virtual reality group

compared with those in the control group. Visual instability is one of the vestibular symptoms that affects balance and equilibrium. Virtual reality has been used during vestibular rehabilitation sessions and has demonstrated positive changes in posturography, vertigo, and mental health [15]. The multimodal protocol improves balance outcome measures according to one study [16].

Benign Paroxysmal Positional Vertigo maneuvers:

The number of canal repositioning maneuvers was not higher in the post traumatic group in comparison with the idiopathic group. Brandt–Daroff exercises are used in recalcitrant BPPV but are generally not considered as effective as the canalith repositioning maneuver 1-2 sessions were effective in treating BPPV [17]. A recent review provides evidence about the various versions of the repositioning maneuvers and their efficacy. Physical therapy is an integral aspect of the care of a person with BPPV. Physical therapists not only perform the repositioning maneuvers and patient education but also ensure that the patient's balance is adequate. Persons with BPPV report falls, but at 1-year follow-up they report fewer falls after repositioning. In Germany at a tertiary care balance and vestibular clinic with various vestibular diagnoses, the most frequent therapy provided was medication (61%) and the second most frequent therapy was physical therapy (41%) [18].

CONCLUSION

Falls in elderly is a major problem occurring secondary to dizziness and balance disorders that further causes the fractures, head injuries resulting in disabilities and also there is lack of motivation in elderly population as per given data in previous studies. Vestibular rehabilitation particularly delivered by trained professional showed the effectiveness in reducing the dizziness, frequency of falls and improves balance in elderly population. Evidence from multiple studies supports the effectiveness of vestibular rehabilitation therapy (VRT) as comprehensive care for individuals with dizziness, balance disorder and vestibular hypo-function. More studies should be conducted to have standardized protocol and physiotherapist should be trained in treating this condition.

Declaration by Authors

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