

Association between Benign Paroxysmal Positional Vertigo and Balance: A Narrative Review.

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Abstract: Benign Paroxysmal Positional Vertigo (BPPV) is characterized by brief episodes of vertigo, nausea and/or positional nystagmus upon head movements, is produced by the inadequate presence of statocone particles coming from the utricle macula floating in the endolymph of the semi-circular canal or attached to their cupule. BPPV is one of the most common peripheral vestibular disorders leading to balance difficulties and increased fall risks. Most patients complain of a loss of equilibrium and unstable gait during and between the vertigo attacks. Literature was explored on search engines (Google scholar, scihub and PubMed) and databases for articles published from 2014 to 2022. The key search phrase, balance and Benign Paroxysmal Positional Vertigo were used to identify potentially relevant articles. The following inclusion criteria were applied for article selection: (1) studies exploring balance in subjects with BPPV. (2) Studies that rated at a score of 7 or higher according to the Pedro scale. Many n=53 relevant articles were identified. After reading the titles and abstracts and assessing eligibility based on the full-text articles, 27 publications were included in our review. Majority studies showed that the outcome (ADL functions, Postural stability, nystagmus, balance, falls, and signs of consciousness) for BPPV reviewed were significantly associated with equilibrium. It was interpreted that balance was significantly affected in patients of BPPV. Also there was still imbalance in long-term even after successful treatment with repositioning maneuvers. [Chotai B Natl J Integr Res Med, 2025; 16(1): 04-11, Published on Dated: 26/01/2024]

Key Words: Balance, Vertigo, Giddines

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Introduction: The vestibular system plays an important role in maintaining balance and is also critical for optimal function. It provides information about the linear and angular acceleration of the head and detects head position relative to the gravitational axis. In addition, the vestibular system assists in stabilizing gaze via vestibulo-ocular reflex during rapid head movement. The system is also involved in the head and trunk control via vestibulocollic reflex and vestibulospinal reflex for upright posture and balance¹.

Patients with vestibular dysfunction demonstrate impaired balance ability to maintain ability to maintain head stability and adjusting upright posture. Among vestibular disorders, benign paroxysmal positional vertigo (BPPV) is considered the most common peripheral vestibular disorder² Most BPPV patients are idiopathic—that accounts for about 50% to 70% of all cases³. Inadequate presence of statocone particles detached from the utricle macula floating in the endolymph of the semi-circular canal or adhered to cupula. The second most

common cause of the BPPV is head trauma, representing 7% to 17% of all BPPV cases. The onset age of the disorder occurred mostly between aged 50 to 70 years⁴.

Patients with BPPV usually suffer from paroxysmal attacks of positional vertigo and nystagmus during specific movements. In addition, many patients also complain of light headedness, nausea, imbalance, and standing and walking disturbances.

The most common provoking movements include rolling in bed, lying down, sitting up, extending the neck to look up, and bending forward. Various pathophysiological mechanisms have been proposed to explain paroxysmal positional vertigo. Parnes and McClure⁵ in 1992 hypothesized “Canalithiasis,” free-floating debris moving within a semicircular canal. Movement of the debris would cause the endolymph to move away from the cupula, causing cupular deflection and inappropriate excitation.

According to previous studies, patients with BPPV

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have shown impaired balance ability in increased anteroposterior rather than mediolateral body sway after provocative head movement as measured by static posturography⁶. In another similar study, however, significant increase in body sway was noted both on the lateral and anteroposterior planes⁷.

Furthermore, patients with BPPV also have shown poor sensory organization ability detected by means of dynamic posturography⁸. No existing studies identified clearly the balance impairments of the patients with BPPV during the complex and functional movement tasks⁹. Therefore, investigated the balance ability in patients with active, non-treated BPPV during stance on uneven surface, single leg stance, and walking.

Material & Methods: Literature search and study design: Present study concentrated on all the BPPV studies of Vestibular conditions affecting Balance. Articles were searched from November 2014 to February 2022. Publication dates ranged from 2018 to March 1, 2022. Literatures were explored on different search engines - Google

Scholar, Scihub and Pubmed. Three keywords were used- (1) Balance, (2) Benign paroxysmal positional vertigo, and (3) Giddiness. The search was performed combining all the chosen keywords across the above databases.

Selection criteria: Inclusion criteria for our narrative review were-(1) studies exploring alance in subjects with BPPV. (2) Studies that rated at a score of 7 or higher according to the Pedro scale (3) studies in English language. (4) Case reports.

Result: Study Selection : n=53 articles were obtained from the search strategy and following the inclusion criteria 26 studies were excluded. Thus, total 27 studies qualified as per Selection criteria.

Study characteristics: Out of the total 27 studies, 21 studies were RCTs and experimental studies, 4 consisted of meta-analysis and systematic reviews and 2 study included case reports. Studies were selected in this Narrative review, which shows association of BPPV and balance in table.

TITLE/AUTHOR	METHODOLOGY	CONCLUSION
Body Balance in Elderly patients 12 months after treatment for BPPV Solange Martiliano Lanca et al (2013)	Patients with clinical diagnosis of BPPV. Balance Rehabilitation unit, static posturography at three time interval before and after repositioning maneuver and 12 months after treatment.	12 months after treatment of BPPV the static posturography showed balance abnormality similar to those before treatment.
Clinical and functional aspects of body balance in elderly subjects with BPPV Daniela Patricia Vaz (2013)	Patients diagnosed with BPPV CTSIB, TUG and Lower Limb testing.	The elderly patients with BPPV experience functional impairments related to body balance.
Comprehensive Vestibular and Balance testing in Dizzy paediatric population Robert C.O'Reily(2013)	Retrospective review of audiometric, vestibular, balance testing and final diagnosis TUG, SOT and fall efficacy were taken	BPPV along with migraine was second most common diagnosis in dizzy paediatric population with balance impairments.
Vertiginous symptoms and postural balance in elderly with BPPV submitted to Epley's maneuver Camila Nicacio da Silva (2016)	Outcome measures of mCTSIB, DGI, DHI, LOS were taken CRM given for dizziness Symptoms	There were short term improvements with CRM in subjective symptoms and QOL but not all aspects of balance.
Effects of balance VRT in elderly with BPPV: A Randomized Controlled Trial	Experimental group receiving VRT along with CRM and control group receiving only	The patients who received additional balance VRT demonstrated better results in

Karyna Myrelly Oliveira Bezerra(2016)	CRM Outcome measures: static and dynamic standing balance, dizziness symptoms and QOL. 3 months study duration.	dynamic balance than control group with no major difference between dizziness symptom and functional measures.
Balance improvement in patients with BPPV wen-Ching chang (2017)	Two groups- experimental groups received canalith repositioning manoeuver and vestibular rehabilitation & control group received only canalith manoeuver. Static balance tests, tandem walk test, DGI were taken.	In experimental group improve balance ability and functional gait performance among patients with BPPV at 4 weeks
Impact of diabetes on mobility, balance and recovery after repositioning maneuvers in individuals with BPPV. Linda J.D'Silva (2017)	Subjects were examined for symptom severity, mobility and postural sway by DHI, FGA and postural sway using accelerometer.	Patients with Posterior SCC with or without type 2 DM have functional deficits in ADLs, mobility and balance
Impact of osteopathic therapy on proprioceptive balance and quality of life in patients with dizziness L Papa (2017)	Patients with BPPV randomly assigned in two groups. Osteopathic treatment and sham therapy group Dizziness handicap inventory and stabilometric platform for balance	Osteopathic manipulative therapy could be useful approach to reduce imbalance symptoms and improve quality of life in patients with vertigo.
BPPV is a Common cause of dizziness and unsteadiness in large Population of 75 years olds. Lena Kollen, (2017)	Subjects above 75 were given questionnaire regarding dizziness problems Evaluated by side lying test, static balance and dynamic walking test.	Subjective and Objective unsteadiness, dizziness and balance difficulties are more severe in elderly with BPPV.
BPPV and clinical test of sensory interaction and balance in Ankylosing Spondylitis. Juan C Amor (2018)	Dix hall pike and cephalic rotational tests and CTSIB were performed.	Increased frequency of abnormal postural control in CTSIB test of vestibular origin.
Vertigo, dizziness and imbalance in elderly S Polat (2018)	Retrospective analysis was evaluated the diagnosis of vertigo, dizziness and imbalance in BPPV	93.5% of elderly patients studied had peripheral vertigo and BPPV ranking first among them (42.43%)
Balance performance when responding to visual stimuli in patients with BPPV Pei-Yun Lee (2020)	Three conditions given to 3 group of people, BPPV patients, older subjects and young subjects, Eyes open,2)Watching a static picture via video display.3)watching a rotating	Patients with BPPV showed similar balance control to older adults, but poorer balance control than young adults. There is lack of standing balance control in the coronal plane of pts with BPPV, which might affect balance strategy after external perturbations.

	visual scene. AP, lateral and total sway path during standing analyzed.	
Postural Control in horizontal BPPV Stefano Di Girolamo (2020)	Patients with BPPV of horizontal semicircular canal investigated by dynamic posturography	Dynamic posturography detect postural imbalance due to posterior SCC dysfunction. The recovery delay observed in long terms due to persistence of small debris, paralysis of ampullar receptors, or time needed for central vestibular re-adaptation
Vertigo and balance disorder –role of manipulative treatment. Systemic review Marco Tramontano (2020)	Pub med science direct and Google scholar are searched. Studies with OMT were included.	Imbalance is related to BPPV By treating BPPV through OMT balance was improved and reduce fall risk
Effects of customized vestibular rehabilitation on static balance among adults with BPPV Phui Lin SE (2021)	Adults with idiopathic unilateral posterior canal BPPV were taken. Group A received CVR in addition to CRM and Group B received Only CRM. 6 weeks duration	CVR in addition to CRM improved static balance in adults with BPPV.
Dizziness symptoms, balance confidence and vestibular function in women reporting dizziness and unsteadiness Ellen Lindell (2022)	Women reporting dizziness on a daily or weekly basis. DHI, activities specific balance confidence scale walking speed and TUG test taken.	Women reporting higher levels of distress due to dizziness had reduced walking speed and reported less balance confidence and higher level of anxiety and depression.
Canalith repositioning maneuvers improve the postural balance and fear of falling with BPPV Patients. Lieselotte Langens (2022)	Static balance using portable kinematic sensor were taken. Mini balance evaluation test, CTSIB on balance and fall efficacy scale taken before and after canalith reposition.	CRM might not be effective in correcting balance completely and reducing fear of fall.
Correlation between the body balance and functional capacity from elderly with chronic vestibular disorder Rael Ferreira De Sousa (2021)	DGI and FIM were taken.	Positive correlation between body balance and functional capacity in elderly.
Balance ability in subjects with BPPV Wen Ching chang (2022)	Subjects with posterior semicircular canal BPPV. Static balance measured with eyes open and closed, firm surface and foam surface, single leg stance.	Patients with BPPV demonstrated impaired static and dynamic balance ability particularly when depriving visual and changing proprioceptive inputs.
Reduction of fall in older people by improving balance subjects with BPPV	Subjects with BPPV diagnosed. TUG, SOT and fall efficacy were taken.	Vestibular rehabilitation has proven to be useful in improving balance with instability by reducing dizziness and postural instability

Marcos Rossi (2022)		
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Discussion Patients with active, non-treated BPPV showed impairments in balance as indicated by a greater sway velocity when they stood on uneven surface or stood with one leg without visual inputs, compared to that of healthy adults. With depriving visual and changing proprioceptive inputs, patients with BPPV needed to rely heavily on the vestibular system for balance. The lack of accurate vestibular information from one side may cause ineffective sensory organization and abnormal vestibule-spinal output and thus result in increased sway in such conditions. Patients with uncompensated unilateral peripheral vestibular dysfunction may have difficulty maintaining an upright posture when both visual and proprioceptive inputs are altered¹⁰. Patients with BPPV, however, demonstrated less sway velocity during the stance on the firm surface with eyes open and eyes closed. In these conditions, patients relied heavily and successfully on visual or proprioceptive inputs to maintain upright posture as steadily as possible. Patients with BPPV used these sensory inputs to compensate for vestibular dysfunction.

In previous studies, DiGirolamo et al⁸ found that patients with BPPV showed impairments of postural control in conditions with altering either proprioceptive, visual or both inputs during the sensory organization test. Blatt et al⁹ found patients with BPPV showed increased postural sway specifically in conditions with altering proprioceptive inputs combined with altering or depriving visual inputs as measured by computerized dynamic posturography. It can be shown that patients with BPPV have normal stability in stable platform with or without altering visual inputs. These patients have below-normal stability in altering proprioceptive and depriving visual inputs¹⁰.

Our study also confirmed the previous findings. With depriving visual and changed proprioception inputs, patients with BPPV demonstrated impaired static standing balance. Study also found that patients with BPPV showed greater sway velocity in the single leg standing than standing with both feet on a firm or foam surface. In single leg stance test, there were narrower base of support and greater challenge to standing stability. Patients with BPPV needed to pay more effort on sensory organization and

muscle co-contraction to maintain standing balance. With eyes open, less sway was noted, even not significantly, when standing on right leg than on left leg. It might be due to the right dominant lower extremity of patients. Nevertheless, under eyes closed condition, patients with BPPV showed greater sway velocity compared to the age-matched norm values of the healthy adults. The majority of the patients showed difficulty in maintaining balance during single leg stance with eyes closed test¹¹.

The visual and proprioceptive inputs were more important for patients with BPPV to use than those for healthy adults. It is evident that single leg standing balance is difficult for subjects with BPPV. It is therefore beneficial to the patients with vestibular disorders that vestibular rehabilitation includes specific exercises to improve single leg standing balance¹. During tandem walk test, patients with BPPV showed slower walking speed and greater end sway velocity compared to that of the healthy adults. Because of the narrow base of support, patients needed to slow down for dynamic balance¹².

At the end of tandem walk, deceleration of the centre of gravity was required to hold the body steadily. Greater end sway velocity observed in the patients with BPPV showed the vestibular dysfunction to detect linear deceleration and thus result in abnormal vestibule-spinal output to stabilize trunk. Lacour et al have shown that producing a unilateral vestibular neurectomy in baboons induces asymmetrical excitability in ipsilateral and contralateral spinal reflexes. Impairment of the function of vestibule-spinal reflex is believed to contribute to postural disturbances in patients with peripheral vestibular disorders^{13,14}.

In summary, our study showed that balance function was impaired in patients with BPPV during the complex and functional movement tasks by means of the Balance Master system. Patients with unilateral BPPV demonstrated impaired static and dynamic balance ability particularly when the visual and proprioceptive inputs were changed. Clinically, patients with BPPV are usually referred for CRM that is effective on symptoms relief and balance. Not all patients improved to normal postural stability after CRM¹⁴. If a patient still showed balance

impairment even after receiving CRM, balance retraining with altering visual and proprioceptive inputs to emphasize vestibular function may be a useful adjunct to treatment for patients with BPPV.

Conclusion: It was interpreted that balance was significantly affected in patients of BPPV. Also there was still imbalance in long-term even after successful treatment with repositioning manoeuvres.

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