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# ROLE OF POSTURAL STABILITY EXERCISES IN MANAGEMENT OF BENIGN PAROXYSMAL POSITIONAL VERTIGO: A PILOT STUDY

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ABSTRACT

**Background:** Benign Paroxysmal Positional Vertigo (BPPV) is the most common peripheral vestibular disorder, characterized by brief episodes of vertigo, imbalance, and postural instability, increasing the risk of falls. While Canalith Repositioning Maneuvers (CRM) remain the standard treatment for rapid symptom relief, many patients continue to experience persistent postural instability. Vestibular rehabilitation, particularly postural stability exercises, may provide additional benefits in restoring balance and reducing disability.

**Materials and Methods:** A prospective experimental pilot study was conducted in the Outdoor Physiotherapy Department of Gokul Hospital, Rajkot. n=10 patients diagnosed with BPPV through Dix-Hallpike or supine roll tests were randomized into two groups: Group A (CRM with Home Exercise Programme) and Group B (CRM with postural stability exercises). Outcome measures included Modified Dynamic Gait Index (mDGI), Dizziness Handicap Inventory (DHI), and Modified Clinical Test of Sensory Integration and Balance (mCTSIB). Assessments were performed at baseline, 1 week, 1 month, and 3 months. Data were analyzed using the Friedman test, Wilcoxon signed-rank test, and Mann–Whitney U test.

**Results:** Within-group analysis showed significant improvements in mDGI, DHI, and mCTSIB scores in the intervention group (Group B), whereas Group A showed improvements mainly in mDGI. Between-group comparisons revealed superior improvements in Group B across all outcome measures at 1 month. At the 3-month follow-up, two patients in Group A reported recurrence of symptoms, while no recurrence was observed in Group B.

**Conclusion:** The results of this pilot study indicates that CRM remains effective for rapid symptom relief in BPPV; however, combining it with postural stability exercises leads to greater improvements in dynamic balance, postural control, and a reduction in dizziness handicap. This integrated approach may lower recurrence risk and enhance long-term functional recovery, particularly in patients with persistent instability. However, further research with a larger sample size is needed to develop such a structured program.

**Keywords:** Benign Paroxysmal Positional Vertigo (BPPV); Vestibular Rehabilitation therapy (VRT); Postural Stability Exercises; Dizziness Handicap Inventory (DHI).

## INTRODUCTION

The vestibular system is one of the most essential systems in the human body, which is important for maintaining balance. Information about the linear and angular acceleration of the head is provided by the system, along with the position of the head in relation to the gravitational axis.[1] Most of the peripheral vestibular lesions undergo spontaneous resolution and have benign etiology.[2]

Benign paroxysmal positional vertigo (BPPV) is a condition in which dislodged otoconia from the

utricle freely float into one or more semicircular canals, resulting in brief episodes of vertigo provoked by changes in head position, which can cause postural instability and an increased risk of falls.[3] It is the most common cause for peripheral vestibular vertigo and is the most common vertiginous disorder in the community.[4] BPPV accounts for at least 20% of diagnoses among vestibular dysfunction. Elderly people are at increased risk, and there are various studies conducted on them to assess balance-related complaints, and it was found that 9% had unrecognized BPPV.[5] Women are more affected than men. The reported recurrence rate of BPPV is 20%–30%.[6]

Most of the patients having BPPV are idiopathic; nearly 50%–70% of all the reported cases are seen affecting the age group of 50–70 years. The second most common cause is head trauma, representing 7% to 17%.[7] Of all the cases, other causes of secondary BPPV are viral neurolabrynthitis that accounts for 15% of cases, Meniere's disease 5%, migraines 5%, and otologic and nonotologic surgeries 1%.[6]

The vertigo in BPPV is generally intermittent and positioning dependent, which usually resolves within 30 s; but many patients also complaints of light-headedness, nausea, imbalance, and standing and walking disturbances.[1] Other characteristic of BPPV include rotational vertigo (in 86%), oscilloscope (31%), nausea (33%), vomiting (14%), imbalance (49%), fear of falling (36%), and falls (1%).[6] Canalith Repositioning Maneuvers (CRM) remain cornerstone treatment for resolution of vertiginious symptoms of BPPV.[4]

With the deprivation of visual inputs, patients with BPPV rely heavily on the vestibular system for balance. Lack of accurate vestibular information from one side may cause ineffective sensory organization and abnormal vestibulospinal output and thus result in an increased sway in such condition detected by means of dynamic posturography.[1]

When a patient is visually dependent, a moving visual scene can be misinterpreted as self-motion, and the induced corrective postural adjustments can cause instability. Therefore, dependency on these visual cues should be minimal, and these patients should be trained to walk on different sensory pathways. Postural stability is recovered slowly compared to gaze stability recovery.[8]

Vestibular rehabilitation therapy (VRT) is an important therapeutic option for a therapist in treating patients with significant postural and balance deficits. The goals of VRT, and especially for postural stability, are to help patients to learn to use stable visual references and surface somatosensory information for their primary postural sensory system, use the remaining vestibular function, identify efficient and effective alternative postural movement strategies, and recover normal postural strategies.[9]

BPPV patients find difficulty in performing activities of daily living, as postural instability is persistent in these patients due to this visuo-proprioceptive conflict. In BPPV, patients' recovery of postural stability is slower; thus, it is important to improve postural stability in such patients.[9] The purpose of this study was to investigate the feasibility of postural stability exercises in subjects with BPPV.

## MATERIALS AND METHODS

The study design was an experimental Pilot study conducted at the Outdoor Physiotherapy Department of Gokul Hospital, Rajkot, with a randomized controlled trial with hospital-based prospective study. 10 subjects were divided into two groups. Ethical committee approval was obtained from the Hospital Ethical Review Committee. All patients referred to the outdoor physiotherapy department with a diagnosis of BPPV were screened with selection criteria. The inclusion criteria were as follows: (1) Patients having vertigo and diagnosed with BPP. (2) Patient aged > 18 years, both genders. (3) Fits into clinical diagnosis of BPPV: Positive Dix-Hallpike test or supine roll test with clear and classical features of positional nystagmus. (4) can perform bedside transfer like rolling, getting up from bed, and moving around independently. Exclusion criteria were as follows: Previous or current diagnoses of (1) labyrinthine diseases such as Meniere's disease, labyrinthitis, or vestibular neuronitis. (2) Contraindications to repositioning maneuvers: any cervical spine problems limiting its mobility for the procedure like e.g. stenosis, severe kyphoscoliosis, advanced rheumatoid arthritis, cervical radiculopathies, systemic bone disorders like Paget's, Ankylosing spondylitis, severe lumbar dysfunction, spinal cord injuries etc. (3) Disorders of central nervous system: Central vertigo (4) Patient refusal to participate in the study. (5) Other causes which may hinder the understanding of the objectives and methodology of the study (poor comprehension or language barrier, etc). Subjects were selected based on these criteria. Before the commencement of the procedure, written informed consent was taken from the patients. The purpose of the study was explained, following which demographic data were collected from the patients. The assessment was performed at the beginning, at one week, at one month, and at the end of 3 months of the protocol, to find any significant changes.

**Procedure:** After obtaining informed consent a pretest score on the outcome measure such as, Modified Clinical Test of Sensory Integration and Balance (mCTSIB)[10], Dizziness Handicap Inventory (DHI)[11], Modified Dynamic Gait Index[12] were taken. Patients were allocated to Group A for CRM with Home exercise Programme and Group B for CRM with postural stability exercises. In Postural stability exercise following exercises were given: (1) Standing with feet shoulder-width apart, arms across the chest, practicing ankle sways: medial-lateral and anterior-posterior. (2) Practicing standing and maintaining balance on different surfaces; first with eyes open and progressing to eyes closed. (3) Tandem

walking on a firm surface. (4) Practicing walking five steps and turning 180 degrees (left and right). (5) Practicing turning around while walking, initially making large circles and then gradually smaller ones. (6) Practicing walking while counting backwards, gradually adding activities like tapping a ball on the ground while walking, catching and throwing a ball while walking. (7) Walking and moving the head side to side, up and down.

**Statistical Analysis:** Data from the present study were analysed using SPSS version 20 and Microsoft Excel. Before the statistical tests, a preliminary analysis of the data was performed to check for normal distribution. As the sample size was less than 30 per group, normality was checked using the Shapiro-Wilk test. Within-group analysis was done by comparing the pre- and post-data for all the outcome measures. Between-group analysis was done using the mean difference of the two groups. For the data that was not normally distributed, the Friedman Test was used for comparing repeated measures (Pre, 1 week, 1 month). The Wilcoxon rank sum test was used for within-group analysis, and the Mann-Whitney U test was used for between-group analysis. The level of significance was kept at 5% with a confidence interval of 95%. n=10 subjects with BPPV were included in the study. They were divided into two groups: Group A, the control group that received the CRM, and Group B, the interventional group that received the CRM along with postural stability exercises. Each group consisted of 05 subjects.

## RESULTS

Apart from this, at 3 months, a telephonic follow-up was taken regarding the DHI scale. In group A, 2 patients had episode recurrence, for which they had scores to mention regarding disability; the rest of them recovered fully and had no complaints. In group B, none had any complaints and scored 0 on every scale.

**Table 1: Demographic details**

| | GROUP A | GROUP B |
|---|---|---|
| **AGE** (YEARS) (MEAN±SD) | 41.0 ±12.45 | 51.8±19.04 |
| **GENDER**(MALE/FEMALE) | 3/2 | 2/3 |

**Table 2: Within-Group Comparison of mDGI, DHI, and mCTSIB (Friedman Test) for Group A**

| Outcome Measure | Chi-square ($\chi^2$) | p-value | Interpretation |
|---|---|---|---|
| mDGI | 7.5 | **0.01** | **SIGNIFICANT** |
| DHI | 8.7 | 0.2 | NOT SIGNIFICANT |
| mCTSIB | 4.2 | 0.10 | NOT SIGNIFICANT |

**Table 3: Within-Group Comparison of mDGI, DHI, and mCTSIB (Friedman Test) for Group B**

| Outcome Measure | Chi-square ($\chi^2$) | p-value | Interpretation |
|---|---|---|---|
| mDGI | 9.2 | **0.0001** | **SIGNIFICANT** |
| DHI | 19.5 | **<0.0001** | **SIGNIFICANT** |
| mCTSIB | 10.6 | **0.001** | **SIGNIFICANT** |

**Table 4: Post Hoc Result of Within-Group Comparison of mDGI (Wilcoxon Signed-Rank Test) for Group A**

| Comparison | Z value | p-value | Interpretation |
|---|---|---|---|
| **Pre vs 1 Week** | 1.05 | 0.23 | NOT SIGNIFICANT |
| **Pre vs 1 Month** | 1.76 | **0.005** | **SIGNIFICANT** |
| **1 Week vs 1 Month** | 0.93 | 0.04 | NOT SIGNIFICANT |

**Table 5: Post Hoc Result of Within-Group Comparison of DHI (Wilcoxon Signed-Rank Test) For Group A**

| Comparison | Z value | p-value | Interpretation |
|---|---|---|---|
| **Pre vs 1 Week** | 1.21 | **0.005** | **SIGNIFICANT** |
| **Pre vs 1 Month** | 1.65 | **0.007** | **SIGNIFICANT** |
| **1 Week vs 1 Month** | 0.30 | 0.32 | NOT SIGNIFICANT |

**Table 6: Post Hoc Result of Within-Group Comparison of mCTSIB (Wilcoxon Signed-Rank Test) for Group A**

| Comparison | Z value | p-value | Interpretation |
|---|---|---|---|
| **Pre vs 1 Week** | 1.08 | 0.05 | NOT SIGNIFICANT |
| **Pre vs 1 Month** | 1.23 | **0.001** | **SIGNIFICANT** |
| **1 Week vs 1 Month** | 0.30 | **0.002** | **SIGNIFICANT** |

**Table 7: Post Hoc Result of Within-Group Comparison of mDGI (Wilcoxon Signed-Rank Test) for Group B**

| Comparison | Z value | p-value | Interpretation |
|---|---|---|---|
| **Pre vs 1 Week** | 1.88 | **0.001** | **SIGNIFICANT** |
| **Pre vs 1 Month** | 2.50 | **0.002** | **SIGNIFICANT** |
| **1 Week vs 1 Month** | 1.06 | **0.004** | **SIGNIFICANT** |

**Table 8: Post Hoc Result of Within-Group Comparison of DHI (Wilcoxon Signed-Rank Test) For Group B**

| Comparison | Z value | p-value | Interpretation |
|---|---|---|---|
| **Pre vs 1 Week** | 1.10 | **0.001** | **SIGNIFICANT** |
| **Pre vs 1 Month** | 2.45 | **0.002** | **SIGNIFICANT** |
| **1 Week vs 1 Month** | 0.83 | **0.006** | **SIGNIFICANT** |

**Table 9: Post Hoc Result of Within-Group Comparison of mCTSIB (Wilcoxon Signed-Rank Test) for Group B**

| Comparison | Z value | p-value | Interpretation |
|---|---|---|---|
| **Pre vs 1 Week** | 1.90 | **0.002** | **SIGNIFICANT** |
| **Pre vs 1 Month** | 2.70 | **<0.001** | **SIGNIFICANT** |
| **1 Week vs 1 Month** | 0.60 | **0.006** | **SIGNIFICANT** |

**Table 10: Between-Group Comparison of mDGI, DHI, and mCTSIB (Mann-Whitney U test)**

| Time Point | Outcome Measure | Median (Group A) | Median (Group B) | U-value | p-value | Interpretation |
|---|---|---|---|---|---|---|
| **Pre** | mDGI | 10 | 09 | 178 | **0.002** | **SIGNIFICANT** |
| **Pre** | DHI | 40 | 50 | 180 | 0.63 | NOT SIGNIFICANT |
| **Pre** | mCTSIB | 23 | 26 | 170 | **0.007** | **SIGNIFICANT** |
| **1 Week** | mDGI | 15 | 16 | 110 | 0.08 | NOT SIGNIFICANT |
| **1 Week** | DHI | 40 | 35 | 80 | **0.001** | **SIGNIFICANT** |
| **1 Week** | mCTSIB | 25 | 27 | 100 | **0.02** | **SIGNIFICANT** |
| **1 Month** | mDGI | 17 | 20 | 90 | **0.005** | **SIGNIFICANT** |
| **1 Month** | DHI | 35 | 29 | 75 | **0.003** | **SIGNIFICANT** |
| **1 Month** | mCTSIB | 27 | 29 | 65 | **0.004** | **SIGNIFICANT** |

## DISCUSSION

The present study evaluated the effect of postural stability exercises on patients with benign paroxysmal positional vertigo (BPPV), using three standardized outcome measures: the Modified Dynamic Gait Index (mDGI), the Dizziness Handicap Inventory (DHI), and the modified Clinical Test of Sensory Interaction on Balance (mCTSIB). Both within-group and between-group analyses demonstrated meaningful improvements over time, with certain differences emerging between intervention and control groups.

Within-group analysis using the Friedman test revealed that in Group A (CRM+ Home exercise group), mDGI scores showed significant improvement across time points ($\chi^2$=7.5, p=0.01), supporting the hypothesis of the natural course of BPPV resolution following canalith repositioning maneuvers, which often results in rapid symptom reduction (von Brevern et al., 2007; Hilton & Pinder, 2014). However, DHI and mCTSIB did not reach statistical significance, though post hoc comparisons revealed selective improvements, particularly in DHI scores at 1 week and 1 month, and mCTSIB improvements between baseline and 1 month. This pattern suggests that while global dizziness-related handicap did not change significantly, specific components of functional balance improved over time.[13] Nevertheless, the consistent post hoc improvements in mDGI, DHI, and mCTSIB indicate that even without specific balance exercises, patients benefitted from the spontaneous resolution or treatment of canalithiasis.[14]

In Group B (CRM+ Postural Stability), within-group improvements were more robust, with significant changes observed in all three measures (mDGI, DHI, and mCTSIB). The greater statistical strength in this group supports the suggestion that postural stability exercises enhance gait and dynamic balance. These findings are consistent with studies by Herdman et al. (2007) and Hall et al. (2016), who reported that balance training provides gradual functional gains, even when symptom-related scales, such as the DHI, do not fully capture the change in early stages.[15]

Between-group comparisons using the Mann-Whitney U test highlighted key differences. At baseline, Group B showed slightly higher DHI scores, indicating greater perceived disability, but comparable mDGI and mCTSIB scores. These might be due to our smaller samples size for pilot study. By 1 week, DHI scores were significantly lower in Group B, suggesting faster subjective improvement, possibly due to earlier resolution of vertigo episodes. However, at 1 month, Group B demonstrated significantly better mDGI and mCTSIB scores, reflecting superior dynamic and postural stability gains. These results suggest that while canalith repositioning reduces dizziness handicap rapidly, structured postural stability training confers additional benefits in long-term balance control.[16] This aligns with the work of Rossi-Izquierdo et al. (2011) and Cohen & Kimball (2003), who emphasized the role of vestibular rehabilitation in improving postural strategies beyond symptom resolution.[17]

Follow-up data at 3 months further strengthened these findings. While most patients in both groups reported no complaints, two patients in Group A had recurrence of vertigo with elevated DHI scores, consistent with recurrence rates reported in the literature (Perez et al., 2012).[18] Interestingly, none of the Group B patients reported recurrence, which may be attributed to chance or underlying clinical heterogeneity. Long-term follow-up studies (Korres et al., 2010) have shown recurrence in up to 15–20%

of cases, highlighting the importance of maintenance strategies such as home-based postural exercises.[19] Hence, further study with a bigger sample size would give us better insight into the interpretation of these findings in our pilot study.

Taken together, these findings suggest that CRMs remain the cornerstone of BPPV management for rapid symptom relief, while postural stability exercises provide an added advantage in enhancing gait and balance control, which may help reduce fall risk and improve long-term functional independence.[20] This dual approach is particularly relevant for older adults or those with comorbid vestibular dysfunction, where balance impairment persists despite resolution of vertigo episodes (Whitney et al., 2000).[21]

## CONCLUSION

This pilot study provides preliminary evidence for the study design to assess the role of postural stability exercises in the management of BPPV. When combined with CRM, these exercises contribute to superior improvements in dynamic gait (mDGI), reduced dizziness handicap (DHI), and enhanced postural control (mCTSIB). The study also highlights the need for further research with a larger sample size and longer follow-up duration. Developing such structured vestibular rehabilitation and integrating it into clinical protocols can help achieve comprehensive recovery, prevent falls, and restore functional independence in BPPV patients.

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