Video Occulography-Assisted Diagnosis of BPPV and Comparison of Pre- and Post-Intervention Dizziness Handicap Inventory Score

Sidra Khan[1] Richa Agrawal[1] Sameer Nivsarkar[1] Shrikant Phatak[1] Abhik Sikdar[1]

[1]Department of ENT, Choithram Hospital and Research Centre, Indore, Madhya Pradesh, India

Address for correspondence Richa Agrawal, MS ENT, DNB (ENT), Department of ENT, Choithram Hospital and Research Centre, Indore-452014, Madhya Pradesh, India (e-mail: agrawal23richa@gmail.com).

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Abstract

Benign paroxysmal positional vertigo (BPPV) is a commonly recognized vestibular disorder which is characterized by brief periods of vertigo and a characteristic nystagmus. The nystagmus is often difficult to appreciate with naked eyes and hence video oculography is a helpful tool. Dizziness Handicap Inventory is an objective way to assess the impact of vertigo on quality of life.

Objective Our study here aims at diagnosing undiagnosed, difficult and missed cases of BPPV using video-oculography and managing it with repositioning manoeuvre. This study also aims at measuring Dizziness Handicap Inventory Scores pre and post repositioning manoeuvre. We also observed the association between Vitamin D levels and the occurrence of BPPV.

Methods and Materials One hundred and twenty-six patients were enrolled in the age group of 18-70 years. After recognizing patients with BPPV, vertigo evaluation was performed. Those patients with suggestive history and suspicion of multiple canal involvement were taken for video-oculography.

Results Forty-four patients were in age group of 50-60 years, having female predominance. 35.71% cases which were missed on clinical examination were correctly diagnosed using video-oculography. The mean pre-intervention DHI was 41.29 ± 15.90 which lowered down to 14.84 ± 11.52 in post-intervention period. The highest DHI scores were seen in multi-canal BPPV involving lateral and posterior semi-circular canals.

Conclusion With the help of vide-oculography we could diagnose more cases of anterior and multi canal BPPV which are often missed. Maximum number of participants had insufficient levels of Vitamin-D and in our opinion correcting it would reduce the occurrence and recurrence rate..

Keywords
- balance diseases
- BPPV
- Dizziness Handicap Inventory
- video-oculography

Introduction

Vertigo and dizziness cover several multisensory and sensorimotor syndromes of various etiologies and pathogenesis. It may be central or peripheral in origin.[1] Benign paroxysmal positional vertigo (BPPV) is a commonly recognized vestibular disorder, accounting for approximately one-third of the cases. It is characterized by brief periods of vertigo triggered by a changing head position relative to gravity.[2] The

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first clinical description of positional vertigo is attributed to Barany in 1921 and in 1952, Dix and Hallpike were the first to clearly describe the provoking maneuvers.[3]

BPPV have an estimated lifetime prevalence of 2.4%. In studies of both young adults and the elderly, a prevalence of 9% has been described.[3] The incidence of BPPV increases with age. BPPV is often unrecognized in older adults. Epidemiologically, fourth and fifth decades of life are the most commonly afflicted age groups but may also affect the younger population. There has been reported to be higher incidence in females.[4]

BPPV affects the calcium carbonate crystals, otoconia, in the sensory organs of inner ear, macula of utricle and saccule. They have a greater density than the surrounding endolymph, thus making the macula sensitive to changes in linear acceleration and, importantly, gravity. The semi-circular canals, in contrast, are sensitive to changes in angular acceleration. In BPPV, otoconia from the utricle is thought to collect in the semi-circular canals, making them abnormally gravity sensitive. The net result is that changes in the head position with respect to gravity result in an abnormal displacement of the cupula and stimulation of the corresponding vestibular afferents. This results in the characteristically abnormal eye movements and vertigo.[3]

Most cases of BPPV are idiopathic in origin and probably result from the degeneration of the macula. Some risk factors can increase its incidence such as old age, osteoporosis, vitamin D deficiency, and vertebro-basilar insufficiency.[5] Several studies indicated the association between BPPV with osteoporosis and vitamin D deficiency, implying that abnormal calcium metabolism may underlie BPPV.[6] Secondary causes of BPPV refer to identifiable causes of otoconial dislodgement. These include otologic and non-otologic surgery, head trauma, vestibular neuritis, and Meniere's disease and sudden sensorineural hearing loss.[7]

Any of the semi-circular canals can be affected by BPPV, but in the great majority of cases, only the posterior canal (80–90%) is involved although occasionally the lateral (5–10%) and the anterior semi-circular canal (1–2%) is affected. Unilateral BPPV is much more common than bilateral involvement. BPPV that simultaneously involves multiple canals is rare and usually affects canals in the same labyrinth. The elicitation of more than one pattern of nystagmus by the positional and positioning maneuvers suggests a combined lesion that affects more than one semi-circular canal at the same time.[8]

The definite diagnosis of BPPV requires diagnostic positional maneuvers that lead to the observation of a canal specific positional nystagmus. Positional testing involves the provocation of vertigo and nystagmus, and different maneuvers test different semi-circular canals, e.g., DixHall Pike maneuver for posterior semi-circular canal, supine head roll test for lateral semi-circular canal, supine head extension maneuver for anterior semi-circular canal. A canal specific response is diagnosed when a rotation of the head in the plane of a semicircular canal evokes positional nystagmus of maximal intensity (in terms of slow phase velocity).

Frenzel goggles or video-oculography can be helpful, particularly when the nystagmus is weak or momentary[9] The VNG examination provides a unique opportunity for the simultaneous quantitative and qualitative assessment of both horizontal and vertical components of nystagmus.[10] It also assesses the function of the vestibular end organs, central vestibulo-ocular pathway, and oculomotor processes.[11] The nystagmus in BPPV has a crescendo-decrescendo characteristic, and the fine ocular responses, most of the time, are difficult to be seen through Frenzel glasses. Using video-oculography, we can also record the characteristic of nystagmus. The ocular responses on record can be repeatedly examined and analyzed, which ensures reliable evaluation.[12]

An objective way to assess the impact of vertigo on the quality of life. The 25-item Dizziness Handicap Inventory (DHI) was developed by Gary Jacobson and Craig Newman to evaluate the self-perceived handicapping effects imposed by vestibular system disease. The items were sub-grouped into three content domains representing functional, emotional, and physical aspects of dizziness and unsteadiness.[13] Total scores range from 0 to 100 with increasing scores signifying greater perception of handicap because of dizziness. The scoring for the dizziness handicap is done as follows: 16 to 34 points (mild handicap), 36 to 52 points (moderate handicap), 54+ points (severe handicap)[14] (►**Fig. 1**).

Our study here aims at diagnosing more and more patients with complaints of vertigo associated with head and neck movements suggestive of BPPV and managing it with repositioning maneuver. This study also aims at measuring the Dizziness Handicap Inventory pre and post repositioning maneuver and reducing handicap with directed management.

Methods and Materials

The patients presented to OPD or admitted in the Department of Otorhinolaryngology and Head & Neck Surgery, Choithram Hospital & Research Center (CH &RC), Indore, Madhya Pradesh, were included in the study after obtaining a written informed consent. History was documented and clinical evaluation was performed to differentiate peripheral from central causes of vertigo. Positional tests were undertaken to provoke BPPV. In those subjects with a strong history suggestive of BPPV and the absence of nystagmus on clinical positioning tests were further studied with video-oculography. Similarly, those patients showing a classical single canal involvement but with atypical accessory nystagmus (suspected of multi-canal involvement) were further evaluated with video-oculography. With video Frenzel glasses, we documented the characteristic of nystagmus to isolate the semi-circular canal/s that were involved in the causation of vertigo. Serum Vitamin D levels were checked. The repositioning maneuver were performed subsequently for respective canals. The Dizziness Handicap Inventory was documented pre and post repositioning maneuvers.

As per the statistical calculations, 126 samples were included in the study.

DIZZINESS HANDICAP INVENTORY

	Questions	Always	Sometimes	No
P1	Does looking up increase your problem?			
E2	Because of your problem, do you feel frustrated?			
F3	Because of your problem, do you restrict your travel for business or recreation?			
P4	Does walking down the aisle of a supermarket increase your problems?			
F5	Because of your problem, do you have difficulty getting into or out of bed?			
F6	Does your problem significantly restrict your participation in social activities, such as going out to dinner, going to the movies, dancing, or going to parties?			
F7	Because of your problem, do you have difficulty reading?			
P8	Does performing more ambitious activities such as sports, dancing, household chores (sweeping or putting dishes away) increase your problems?			
E9	Because of your problem, are you afraid to leave your home without having without having someone accompany you?			
E10	Because of your problem have you been embarrassed in front of others?			
P11	Do quick movements of your head increase your problem?			
F12	Because of your problem, do you avoid heights?			
P13	Does turning over in bed increase your problem?			

	Questions	Always	Sometimes	No
F14	Because of your problem, is it difficult for you to do strenuous homework or yard work?			
E15	Because of your problem, are you afraid people may think you are intoxicated?			
F16	Because of your problem, is it difficult for you to go for a walk by yourself?			
P17	Does walking down a sidewalk increase your problem?			
E18	Because of your problem, is it difficult for you to concentrate?			
F19	Because of your problem, is it difficult for you to walk around your house in the dark?			
E20	Because of your problem, are you afraid to stay home alone?			
E21	Because of your problem, do you feel handicapped?			
E22	Has the problem placed stress on your relationships with members of your family or friends?			
E23	Because of your problem, are you depressed?			
F24	Does your problem interfere with your job or household responsibilities?			
P25	Does bending over increase your problem?			

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)

Fig. 1 Dizziness Handicap Inventory Score.

Results

Majority of the patients were in the age group 51 to 60 (44 patients) years and 61 to 70 years (37 patients) and mean age of 53.07 ± 12.24 with female predilection (69 females and 57 males). In 81 (64.3%) patients, the posterior canal was involved and Epley's maneuver was performed for them; in 39 (30.9%) patients, the lateral canal was involved, Barbecue roll maneuver was performed; in 26 (20.6%) patients, the anterior canal was involved for which Yacovino maneuver was performed (►**Fig. 2**). Multi canal involvement was seen in 20 patients. Canal with more intense nystagmus was reposited first.

In 106 (84.1%) patients, only one canal was involved, while in 20 patients (15.8%), multiple canals were involved. Left side was more common in lateral canal BPPV, whereas the right side was found more common in posterior canal BPPV.

The mean pre-intervention Dizziness Handicap Inventory Score was 41.29 ± 15.90 and the mean post-intervention Dizziness Handicap Inventory score was 14.84 ± 11.52. The difference was found to be statistically significant (p = 0.001), showing a significantly lower post-intervention score (►**Figs. 3** and **4**). In the post-intervention period, at the end of 14 days, 84 (66.7%) patients were totally asymptomatic, 31 patients (24.6%) had mild DHI score, while 11 patients (8.7%) had moderate DHI score. In total, 95 patients (75.4%) required single repositioning maneuver, 23 patients (18.3%) required two maneuvers, while 8 (6.3%) patients required three maneuvers for relief. Theses maneuvers were repeated at an interval of 3 days.

Forty-five patients were taken for video-oculography. Twenty-five patients, who were undiagnosed on clinical evaluation could be correctly diagnosed with video-oculography. Rest 20 cases, the patients who showed a classical single canal involvement but with atypical accessory nystagmus (suspected of multi-canal involvement) on clinical positional testing were diagnosed as multi-canal involvement on VOG.

In our study, 117 patients had vitamin D levels below the normal range, 56 (44.4%) patients had deficient levels (< 25 nmol/L), while 61 (48.4%) patients had insufficient levels of vitamin D (25–75 nmol/L). Only nine (7.1%) patients had sufficient levels (> 75 nmol/L) (►**Fig. 5**). None of the patients had vitamin D levels in the potentially toxic range. The association between the vitamin D status and the number of maneuvers required was found to be statistically not significant.

Discussion

BPPV is a subset of vertigo that is triggered with the stimulation of the vestibular system. Most commonly, it is a disease of elderly women. The dizziness due to BPPV causes moderate handicap in most cases and can be very easily treated with repositioning maneuvers.

The diagnosis and the treatment of BPPV have been assisted with the invent of video-oculography. The video

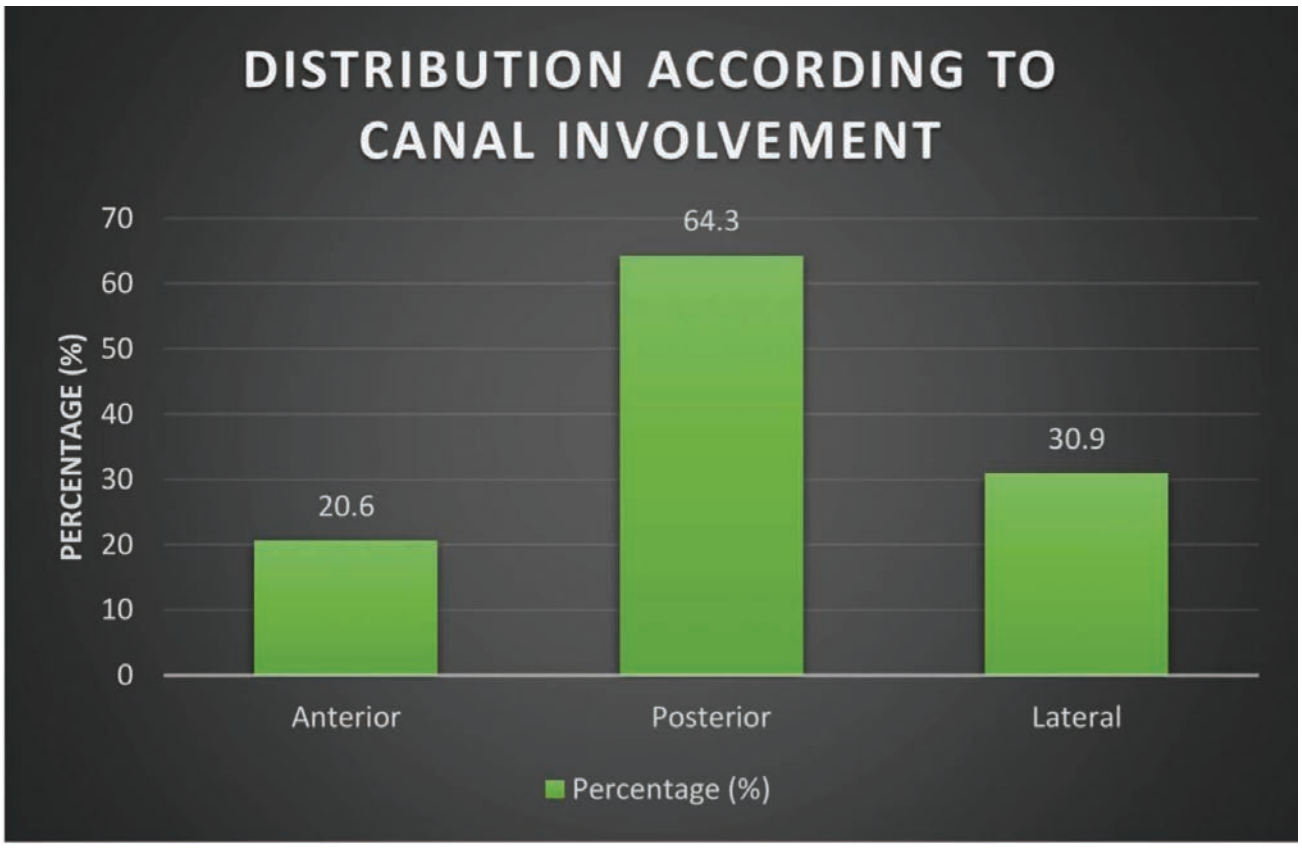

Fig. 2 Distribution of BPPV according to canal involvement.

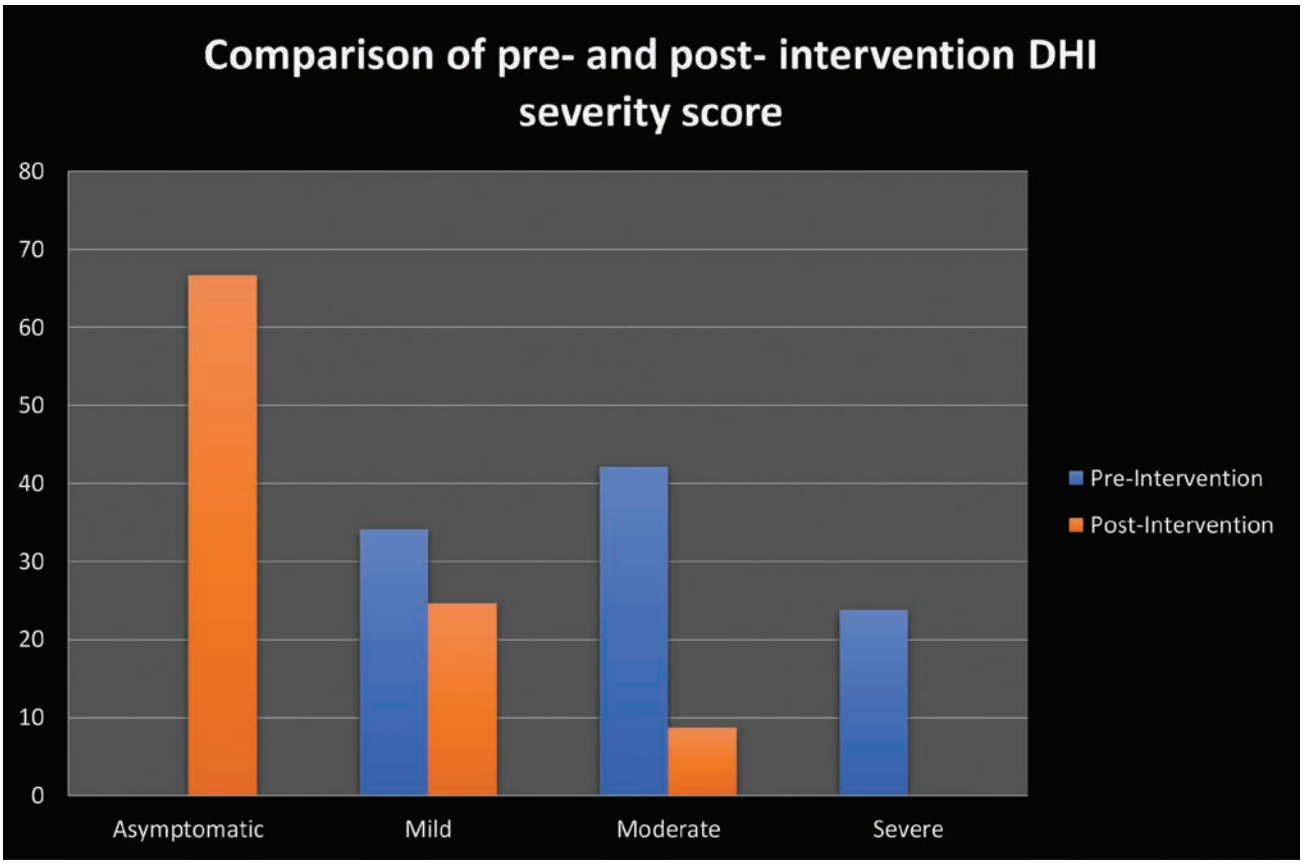

Fig. 3 Comparison of pre- and post-intervention DHI severity score.

Frenzel goggles help to pick up the weak nystagmus, which is not appreciated by the naked eyes. The video Frenzel goggles allow us to record eye movements and nystagmus both with and without fixation.

The studies by von Breveren et al, Furman et al, Swain et al, Shim et al found mean ages of 49.4 (SD 13.8),[4] 54 years,[15] 41.4 years,[2] and 54.4 ± 14.8[16] respectively. These findings were consistent with our findings of mean age of 53.07 ± 12.24 years. All these studies had shown female preponderance similar to our study.

Korres et al[17] and Balatsouras et al[18] had shown involvement of anterior canal BPPV in 1 to 2% cases, while Jackson et al[19] and Lopez-Escamez et al[20] reported anterior canal BPPV in 21.2% cases and 17.14% respectively. The later findings were consistent with findings of our study (20.6%).

Shim et al,[16] Tomaz et al,[8] Balatsouras'[18] and Lopez-Escamez et al[20] had reported multi-canal involvement in 4.6%, 1.5%, 9.3%, and 20% of cases, respectively. In our study, multiple canals were involved in 20 out of 126 cases. Jackson et al,[19] Lopez-Escamez et al,[20,21] and Maslovara et al[22] had shown importance of video-oculography in their studies for precise and accurate diagnosis of anterior canal BPPV and multiple canal involvement. The use of video-oculography has proven beneficial in our study too, where 45 cases out of 126 were diagnosed correctly.

Whitney et al and Martens et al,[23,24] van der Zaag-Loonen et al,[25] Nishino et al,[26] and Amrish et al,[27] have reported higher Dizziness Handicap Inventory score in cases of BPPV. This was similar to the findings of our study with mean pre-intervention score of 41.29 ± 15.90 and the mean post-intervention score of 14.84 ± 11.52. Eighty-four patients were asymptomatic, 31 patients had mild DHI score, while 11 patients had moderate DHI score after repositioning maneuver (►**Figs. 3** and **4**). The maximum pre-intervention DHI was found in cases of anterior canal involvement, which was 44.31 ± 15.37.

Buki et al,[28] Jeong et al,[29,30] and Sheikhzade et al[31] had shown correlation between vitamin D deficiency and BPPV. These studies had also reported to be higher recurrence rate of BPPV in vitamin D deficiency. In our study also, 117 patients had vitamin D levels below the normal range. Fifty-six (44.4%) patients had deficient levels (< 25 nmol/L), while 61 (48.4%) patients had insufficient levels of vitamin D (25–75nmol/L) (►**Fig. 5**).

Conclusion

Video-oculography is a helpful tool in the diagnosis and treatment of benign paroxysmal positional vertigo. It not only helps us to detect the weakest of nystagmus but also correctly diagnose the involvement of canals. Dizziness Handicap Inventory is an objective way to assess functional performance in patients having vestibular disease. The higher number of asymptomatic patients in the post-intervention period in our study lead us to conclude that repositioning maneuvers form the main stay treatment for BPPV.

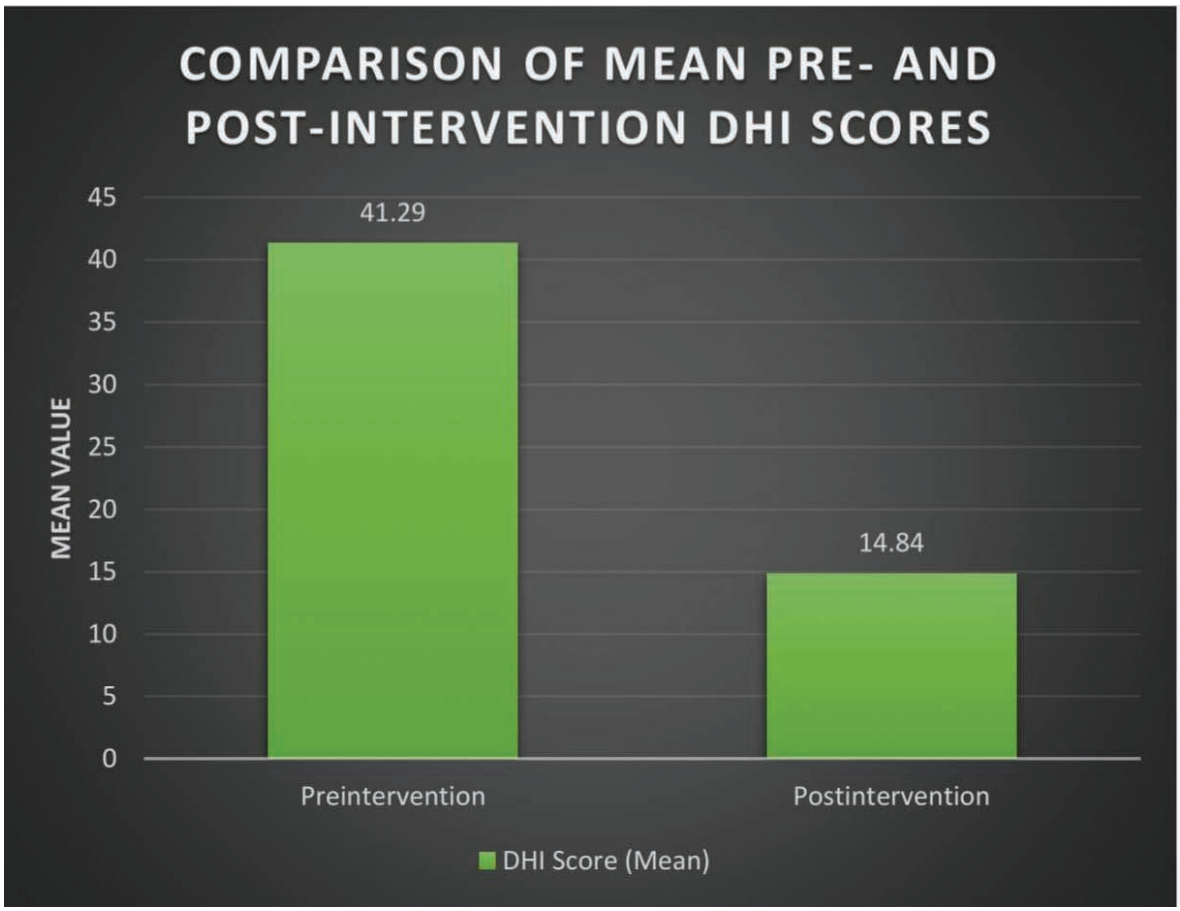

Fig. 4 Comparison of mean pre- and post-intervention DHI score.

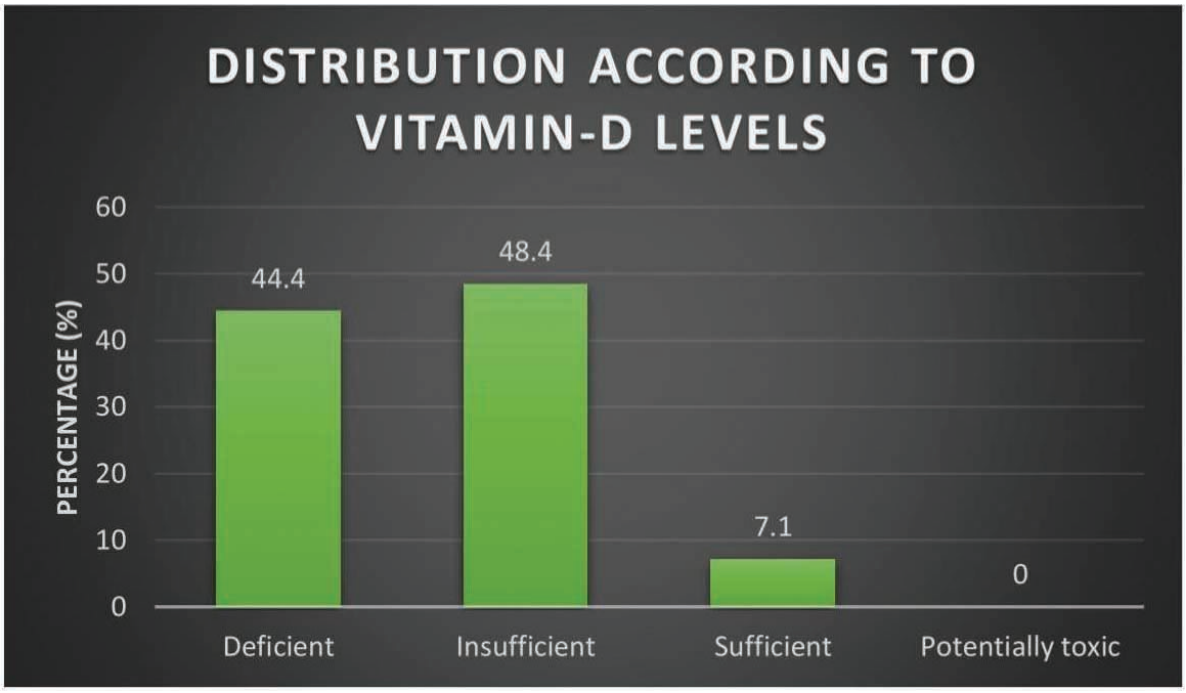

Fig. 5 Distribution as per vitamin D levels.

Correction of vitamin D levels may help to reduce the occurrence of BPPV.

Conflict of Interest

None declared.

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