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Effectiveness of Brandt-Daroff exercises in benign paroxysmal positional vertigo: a systematic review

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Abstract

Introduction. Benign Paroxysmal Positional Vertigo (BPPV) is defined as a disorder of the inner ear characterised by repeated episodes of positional vertigo. BPPV is one of the most prevalent vestibular disorders in the general population, accounting for one-third of all vestibular disorders. The prevalence of BPPV is higher in females than males and this prevalence increases with increasing age. The common non-surgical treatments of BPPV are repositioning manoeuvres and habituation exercises. This review aimed to explore the effectiveness of Brandt-Daroff exercises in patients with BPPV.

Methods. Two search engines, PubMed and Cochrane, were used. Articles focusing on Brandt-Daroff exercises as management of BPPV were included in this review. All articles were published in English and results up to February 2023 were included.

Results. Epley's repositioning manoeuvre is a better treatment option for posterior canal BPPV. Epley's manoeuvre is more effective if applied alone as compared to its application along with Brandt-Daroff exercises or with medication. Epley's manoeuvre was more effective than any other repositioning manoeuvre, such as the Semontmanoeuvre. The application of Brandt-Daroff was ineffective when applied alone. However, it was effective when applied in combination with the Cawthorne-Cooksey exercises in reducing the symptoms of BPPV.

Conclusions. Brandt-Daroff exercises have inconsistent results in the treatment of BPPV; hence, high-quality randomised controlled trials should be carried out to investigate their efficacy.

Key words: benign paroxysmal positional vertigo, vestibular diseases, habituation, rehabilitation

Introduction

"Benign Paroxysmal Positional Vertigo (BPPV) is defined as a disorder of the inner ear characterised by repeated episodes of positional vertigo." "Vertigo is defined as an illusory sensation of motion of either the self or the surroundings in the absence of true motion", while "positional vertigo is defined as a spinning sensation produced by changes in head position relative to gravity" [1]. BPPV is also known as positional vertigo, paroxysmal positional vertigo, benign positional vertigo, and paroxysmal positional nystagmus [1]. BPPV is one of the most prevalent vestibular disorders in the general population and accounts for one-third of all vestibular disorders. Females have a higher prevalence of BPPV compared to males, and as age increases, the prevalence increases [2].

The abnormal mechanical stimulation of 1 or more of the 3 semicircular canals present in the inner ear results in BPPV. The canals, which contain fluid, detect rotation of the head through the deflection of sensory hair cells embedded within a gelatinous membrane, the cupula. The otoconia, which are calcified particles, add weight to the sensory membrane of the macula, which is sensitive to gravitational forces acting on the head. When one becomes dislodged, the sediment changes the dynamics in the canals.

The two common mechanisms for BPPV involvecupulolithiasis and canalithiasis. Cupulolithiasis involves the dislodgement of otoconia that directly attaches to the cupula, adding weight to this membrane. Reorientation of the canal relative to gravity deflects the cupula, which excites or inhibits the ampullary organ. In canalithiasis, the otoconia forms free sediment in the canals. Reorientation of the canals causes the otoconia to move to the lowest part of the canals, generating a drag on the endolymph, resulting in fluid pressure on the cupula, and activating the ampullary organ, causing posterior canal BPPV.

BPPV usually presents as one of two forms in clinical settings. The posterior semicircular canal is involved more frequently than the horizontal semicircular canal in BPPV, which constitutes relatively 85% to 95% of all BPPV cases, while only 5% to 15% of all BPPV cases involve the lateral or horizontal canals. The posterior canal is involved as a result of canalithiasis in BPPV. The fragmented otolith particles are displaced with the movement of head entering the posterior canal, generating inertial alterations to the cupula that result in vertigo and aberrant nystagmus. The lateral canal BPPV occurs due to cupulolithiasis, where the otolith particles adhere to the cupula, resulting in vertigo when head is moved in provocative positions [3].

The most common non-surgical treatments of BPPV are repositioning manoeuvres and habituation exercises. The most common manoeuvre among all these is the canalith repositioning manoeuvre (CRP) or Epley's manoeuvre. This CRP manoeuvre uses gravity for treating canalithiasis of the posterior canal. The habituation exercises commonly used for treating BPPV are Brandt-Daroff exercises. These exercises cause the habituation of the central nervous system (CNS) to the stimulating position as they dislodge the debris from the cupula [4].

There is abundant literature presented on the efficacy of Brandt-Daroff exercises and Epley's manoeuvre for the treatment of BPPV. The Brandt-Daroff exercises can be used alone or in conjunction with other repositioning techniques, regardless of the canals involved. These exercises do not instantly cure vertigo or dizziness; rather, a more gradual im-

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provement is noted if the exercises are repeated a couple of times daily and sustained until patients have gone two days without experiencing any vertigo. In posterior canal BPPV (PC-BPPV), Brandt-Daroff exercises have the most effective treatment outcomes [1]. There is a paucity of literature that explores the effectiveness of Brandt-Daroff exercises in BPPV. Thus, the present review aims to explore the efficacy of Brandt-Daroff exercises in patients with BPPV.

Subjects and methods

Eligibility criteria

PRISMA guidelines were followed for conducting this systematic review. The review was conducted in February 2023. Articles focusing on Brandt-Daroff exercises for the management of BPPV were included in this review. Only randomised trials and articles published until February 2023 in English were included. The articles with scores less than 5 on the Physiotherapy Evidence Database (PEDro) scale were excluded. The systematic review was not registered in PROSPERO, as a lesser number of articles were available exploring the effectiveness of Brandt-Daroff habituation exercises for the treatment of BPPV. Also, due to COVID, there was an excessive influx of trials that needed to be registered in PROSPERO. Therefore, the trial was not accepted by the PROSPERO as it was not accepting trials other than COVID-19 trials.

Information sources

Two electronic databases were used to collect the information: PubMed (MEDLINE) and Cochrane (Central) from inception to February 2023.

Search strategy

Search terms used for locating the pertinent literature in PubMed were “Benign paroxysmal positional vertigo” OR “BPPV” OR “Vertigo” AND “Brandt-Daroff exercises” for the title/abstract in the advanced search options. For searching in Cochrane, (“Benign Paroxysmal Positional Vertigo”): ti, ab, kw OR (“BPPV”): ti, ab, kw OR (“Vertigo”): ti, ab, kw AND (“Brandt Daroff exercises”): ti, ab, kw were used.

Study selection

The search was conducted using the PICOS strategy for a population consisting of BPPV patients, intervention with Brandt-Daroff exercises, and study design as randomised trials. Articles were screened in the order of title, title and abstract, and the availability of the full text. Randomised trials where Brandt-Daroff exercises were performed alone or in combination with other interventions, such as repositioning manoeuvres as a non-surgical means of treatment for BPPV, were selected. Articles using Brandt-Daroff exercises as a treatment for patients with BPPV were selected.

Data collection process

The relevant and eligible studies were screened and scrutinised by the title and abstract, followed by the availability of the full text by the three reviewers (MB, RC, and VR). The MeSH terms and associated keywords were used to extract the data. Three investigators (MB, RC, and J) independently conducted the quality assessment using the PEDro [5]. The extracted information was reviewed for any discrepancies by all the authors and the decision of SJ was considered to be final.

Risk of bias in individual studies

The studies incorporated were assessed as low risk if they met the requirements of a randomisation process, deviations from intended interventions, missing data outcomes, measurement of the outcomes, and selection of reported results. The Risk of Bias 2 (RoB 2) tool, a modified Cochrane risk-of-bias tool for randomised trials in Cochrane Reviews, was used for this.

Results

Study selection

A total of thirty-six studies were obtained from two search engines: PubMed (Central) and Cochrane. Sixteen studies were from the Cochrane Library and twenty studies were from PubMed by using the search strategy explained above. All the studies were screened first through the title and then the abstract. Nine studies were selected for the systematic review after screening, adherence to inclusion and exclusion criteria, and elimination of duplicates. Figure 1 describes the PRISMA flow chart for the selection of the studies.

Study characteristics

Out of nine studies, one study was from Mexico [6], two studies were from India [2, 7] one was from Spain [8], three studies from Turkey [9–11], one from Germany [12] and one from Chicago [13]. All the studies used Brandt-Daroff exercises alone or in combination with other interventions like repositioning manoeuvres and habituation exercises as a non-surgical means of treatment for BPPV and were compared to the other groups. Out of nine studies, only four studies had a control group along with the intervention group [2, 6, 11, 13]. Rest of the five studies had only an intervention group and no control group [7–10, 12]. Four studies out of nine had assessed the effect of interventions based on presence and absence, latency and duration, and complete disappearance of nystagmus [6, 8, 10, 12]. Two studies assessed the effect of treatment based on the Dizziness Handicap Inventory Scale [2, 11], one study assessed the quality of life [9], one study assessed the relief of symptoms [7], and one study as-

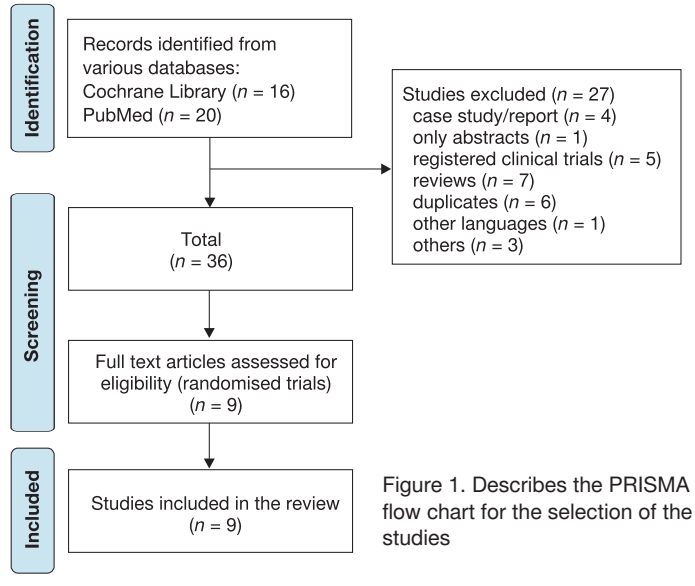

Figure 1. Describes the PRISMA flow chart for the selection of the studies

Table 1. Shows the overview of the included studies

Study number	Authors	Subjects	Study origin	Study design	Intervention group	Control group	Outcome tools	Impressions
1	Çetin et al. 2022 [11]	378 patients with BPPV	Turkey	single-blinded randomised controlled prospective cohort study	2 groups: – Brandt-Daroff exercises (BDE) – Shopping exercises (SE)	no exercise	Dizziness Handicap Inventory (DHI)	Residual dizziness was improved significantly in the SE group as compared to the BDE and control groups.
2	Celis-Aguilar et al. 2022 [6]	38 patients with BPPV	Mexico	single-blinded randomised controlled trial	4 groups: – Brandt-Daroff – Semont – Epley	sham	presence or absence of nystagmus, evaluated on the Dix-Hallpike Manoeuvre	Epley manoeuvre was superior to Brandt-Daroff, "sham" and Semont-manoeuvres in resolution of nystagmus and improvement in DHI in subjects with BPPV.
3	Ramanathan et al. 2019 [2]	20 patients with posterior semicircular canal BPPV	India	single-blinded randomised controlled trial	Brandt and Daroff's exercises and Cawthorne-Cooksey exercises	Brandt and Daroff's exercises	Dizziness Handicap Inventory (DHI)	Cawthorne-Cooksey habituation exercises, along with Brandt-Daroff exercises, are more effective in treating posterior canal BPPV subjects.
4	Cetin et al. 2018 [10]	50 patients with unilateral posterior canal BPPV	Turkey	prospective, randomised, comparative study	2 groups: – Modified particle repositioning manoeuvre – Brandt-Daroff exercises	–	latency and the duration of Nystagmus	Brandt-Daroff exercises and modified Epley manoeuvres are both equally effective in the treatment of BPPV.
5	Ugurlu et al. 2012 [9]	60 patients with posterior canal BPPV	Turkey	randomised trial	3 groups: – Epley manoeuvre – Brandt-Daroff home exercises and Epley manoeuvre – Betahistine dihydrochloride, 24 mg orally twice daily – Epley manoeuvre	–	QOL	Epley manoeuvre, in combination with other procedures, does not change the success of treatment. Epley manoeuvre alone seems sufficient for obtaining a cure in patients with BPPV.
6	Karanjai and Saha 2010 [7]	48 patients with PC- BPPV	India	prospective randomised study	3 groups: – Semont's manoeuvre – Epley' smanoeuvre – Brandt-Daroff exercises	–	relief of symptoms	Epley manoeuvre was better in terms of relief of symptoms and prevention of recurrence.
7	Helminski et al. 2005 [13]	116 patients diagnosed with BPPVPC, successfully treated with the canalith repositioning procedure	Chicago	randomised retrospective clinical trial	Brandt-Daroff exercises	no exercises	2 years follow up and questionnaire mailed every 2 months	Brandt-Daroff exercises do not significantly affect the time or rate of recurrence of BPPVPC.
8	Soto Varela et al. 2001 [8]	106 patients with BPPV	Spain	randomised prospective study	3 groups: – Brandt-Daroff habituation exercises – Semontmanoeuvre – Epley's repositioning manoeuvre	–	Complete disappearance or marked reduction in nystagmus and the sensation of vertigo	Epley's repositioning manoeuvre and Semontmanoeuvre are more effective than Brandt and Daroff habituation exercises.
9	Radtke et al. 1999 [12]	54 Patients of unilateral PC-BPPV	Germany	randomised trial	2 self-treatment groups: – Modified Epley's procedure (MEP group – Brandt-Daroff exercises (BDE) group	–	Absence of positional vertigo and positional nystagmus on Dix-Hallpike testing	For self-treatment of PC-BPPV, MEP is more suitable than conventional BDE.

sessed the time to the recurrence of symptoms [13]. Table 1 represents the overview of included studies [2, 6, 13].

Quality assessment

Table 2 describes the quality assessment of the studies using PEDro scoring. The PEDro scoring was done independently by two authors (MB and RC). The studies were given an overall quality score between six and nine after meeting the requirements for randomisation and allocation concealment, assessor blinding, and intention-to-treat analysis. Out of the nine included studies, the PEDro score of one study was nine out of eleven, one study scored eight out of eleven, one study scored seven out of eleven, and six studies scored six out of eleven on PEDro scoring. Therefore, the quality of the articles ranged from moderate to high (six to nine).

Risk of bias

The risk of bias is presented in Figure 2. In the randomisation process, seven studies revealed low risk [6–9, 11–13] and two studies revealed some concerns [2, 10]. Two studies revealed low risk [6, 11], one study revealed some concerns [2], and six studies revealed high risk [7–10, 13] in domain deviation from the intended intervention. In missing outcome data, five studies were scored at a low risk [6–10], two studies had some concern [12, 13], and two studies revealed a high risk [2, 11]. All the included studies revealed low risk in measuring the outcome and selecting the reported result domains. An overall risk of bias was high in all of the included studies. Table 3 summarises Risk of Bias using the RoB 2 tool, a modified Cochrane risk-of-bias tool for randomised trials in Cochrane Reviews.

Table 2. Describes the quality assessment of the studies using the Physiotherapy Evidence Database (PEDro scoring)

Study number	PEDro scale items	Çetin et al., 2022 [11]	Celis-Aguilar et al., 2022 [6]	Ramanathan et al., 2019 [2]	Cetin et al., 2018 [10]	Ugurlu et al., 2012 [9]	Karanjai and Saha, 2010 [7]	Helminski et al., 2005 [13]	Soto Varela et al., 2001 [8]	Radtke et al., 1999 [12]
1	Specified eligibility criteria	+	+	+	+	+	+	+	+	+
2	Random allocation	+	+	+	+	+	+	+	+	+
3	Concealed allocation	+	+	–	–	–	–	–	–	–
4	Similar baseline	+	+	+	+	+	+	+	+	+
5	Subjects blinding	+	+	+	–	–	–	–	–	–
6	Therapists blinding	–	–	–	–	–	–	–	–	–
7	Assessors blinding	–	–	–	–	–	–	–	–	–
8	Measures of key outcomes from more than 85% of subjects	+	+	+	+	+	+	+	+	+
9	Intention to treat analysis of one key outcome	–	+	–	–	–	–	–	–	–
10	Statistical comparisons between-group of at least one key outcome	+	+	+	+	+	+	+	+	+
11	Variability for at least one key outcome	+	+	+	+	+	+	+	+	+
Total		8	9	7	6	6	6	6	6	6

Table 3. Summarises Risk of Bias using the RoB 2 tool, a modified Cochrane risk-of-bias tool for randomised trials in Cochrane reviews

Study number	Study	Randomisation process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall
1	Çetin et al., 2022 [11]	low	low	high	low	low	high
2	Celis-Aguilar et al., 2022 [6]	low	low	low	low	low	low
3	Ramanathan et al., 2019 [2]	some concerns	some concerns	high	low	low	high
4	Cetin et al., 2018 [10]	some concerns	high	low	low	low	high
5	Ugurlu et al., 2012 [9]	low	high	low	low	low	high
6	Karanjai and Saha, 2010 [7]	low	high	low	low	low	high
7	Helminski et al., 2005 [13]	low	high	some concerns	low	low	high
8	Soto Varela et al., 2001 [8]	low	high	low	low	low	high
9	Radtke et al., 1999 [12]	low	high	some concerns	low	low	high

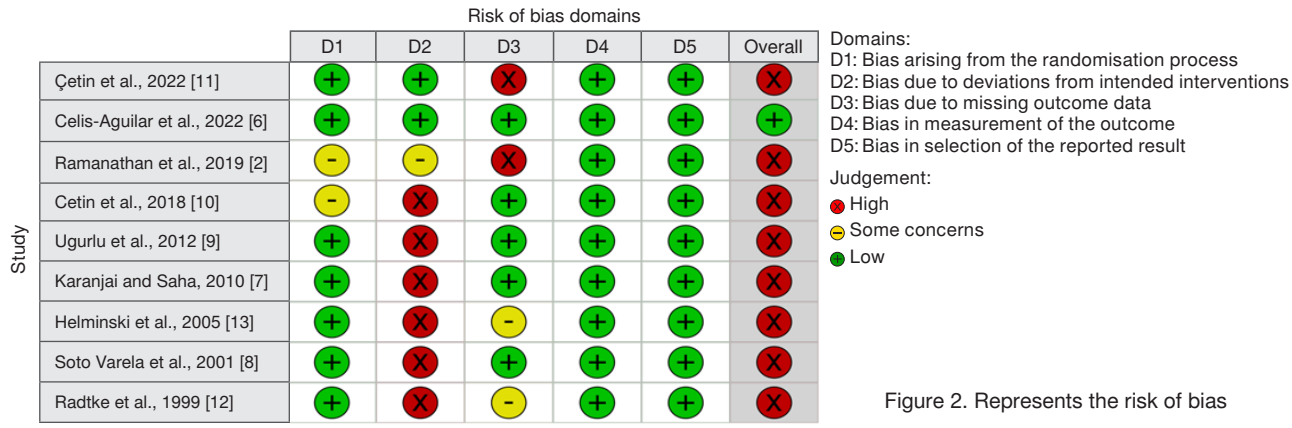

Figure 2. Represents the risk of bias

The result of this systematic review revealed that Epley' repositioning manoeuvre is a better treatment option for posterior canal BPPV. Epley's manoeuvre is more effective if applied alone as compared to its application along with Brandt-Daroff exercises or medications. Therefore, Epley's manoeuvre, if combined with any other treatment, does not affect the result of the treatment.

It was also found that Epley's manoeuvre was more effective than any other repositioning manoeuvres, such as the Semontmanoeuvre. The application of Epley's and modified Epley's manoeuvers were found to be more effective than rehabilitation exercises such as Brandt-Daroff exercises.

The application of Brandt-Daroff was ineffective when used alone. However, it was effective when applied in combination with Cawthorne-Cooksey exercises in reducing the symptoms of BPPV.

Discussion

This systematic review aimed to evaluate the efficacy of Brandt-Daroff exercises in patients with BPPV. Nine studies of moderate-to-high quality and high risk of biases were included in this review. Five out of nine studies focused on a comparison of different repositioning manoeuvres with Brandt-Daroff exercises.

Brandt-Daroff exercises and canalith repositioning manoeuvres are the main therapies for most of the patients with BPPV for treating symptoms [4]. To affect the canal debris, they disperse it into the inactive utricle from the posterior semicircular canal. The Epley's manoeuvre has become particularly popular in recent years. Repositioning techniques are thought to be the most efficient method of treating posterior canal BPPV symptoms. These manoeuvres shift the otoconia from the involved canal back into the vestibule, where it dissolves [1]. The included studies also suggested that Epley's Repositioning manoeuvre is the most effective intervention in treating BPPV [6–8]. Canalithiasis of the posterior canal is treated with the use of gravity. A sequence of four movements of the head and body are used in this manoeuvre which includes sitting to lying, rolling over, and back to sitting. This encourages the movement of the particles through the semicircular ctanals. It is more efficacious than the Semontmanoeuvre and Brandt-Daroff habituation exercises in treating BPPV [6]. While the Brandt-Daroff exercises are used to habituate symptoms, the Semontmanoeuvre, a liberatorymanoeuvre, treats cupulolithiasis of the posterior canal using inertia and gravity. Therefore, Epley's manoeuvre is chiefly used as a treatment for posterior canal BPPV. They are efficient in reducing the symptoms and aiding in the prevention of BPPV recurrence [7].

One of the studies included in this review concluded that Epley's repositioning manoeuvre alone is effective in improving the symptoms of BPPV. If used along with other habituation exercises or medicines, it does not have any significant effect on the result of the treatment [9].

However, one study suggests that both the Epley's manoeuvre and Semontmanoeuvre are more efficacious than Brandt-Daroff exercises. Their results also suggest that the initial cure obtained from the Semontmanoeuvre were more stable than Epley's manoeuvre [8]. Even the Modified Epley's manoeuvre as self-treatment is more efficient than Brandt-Daroff exercises [12]. However, the long-term results of the Epley's manoeuvre were better than the Semontmanoeuvre as Epley's manoeuvre was more effective in the reduction or complete disappearance of the symptoms in BPPV [8].

However, there is a study that suggested that Brandt-Daroff exercises and modified Epley manoeuvres are equally effective in treating BPPV in terms of latency and duration of nystagmus [10]. The Brandt-Daroff exercises are said to be more effective when used along with other habituation exercises, such as the Cawthorne-Cooksey exercises. Brandt-Daroff exercises habituate the CNS to the stimulating position by giving repetitive stimulus to the brain, which reduces the brain's response to it and dislodges the debris from the cupula, while the Cawthorne-Cooksey exercises are basically adaptation exercise. The central nervous system learns to adapt to the imbalance in signals coming from the impaired peripheral vestibular sensory receptors. Hence, the combined effect of these exercises helps in treating the symptoms of BPPV and improves the quality of life of these patients [2].

Despite the great efficacy of the Epley's manoeuvre and the spontaneous resolution of symptoms, BPPV can persist or reoccur. Anxiety and a lower quality of life are a result of the high recurrence rate of BPPV after treatment [14].Therefore, vestibular rehabilitation exercises are taught to the patients to improve their balance and vestibular compensation. It is also suggested that if Brandt-Daroff exercises are performed daily by the patient with BPPV, it has no impact on the time and rate of recurrence of the symptoms of BPPV [13].

The result of this systematic review clearly suggested that Epley's manoeuvre is effective for treating the symptoms of BPPV, as five out of the nine studies indicated that Epley's manoeuvre is more suitable than liberatorymanoeuvres and habituation exercises such as Brandt-Daroff exercises. The effectiveness of Brandt-Daroff exercises have not been proved according to this systematic review. As randomised controlled trials are taken as the gold standard for assessing the effect of the intervention and only a few studies in this review were randomised controlled trials. Therefore, it should be taken into consideration when interpreting and generalising the results of these interventions in the treatment of BPPV. Thus, randomised controlled studies should be carried out to precisely analyse the impact of the intervention to establish the efficacy of Brandt-Daroff exercises.

Conclusions

Brandt-Daroff exercises have inconsistent results in the treatment of BPPV; hence, high-quality randomised controlled trials should be carried out to investigate their efficacy.

Ethical approval

The conducted research is not related to either human or animal use.

Disclosure statement

None of the authors have any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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