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[Intervention Protocol]

Epley maneuver, performed by family doctors or emergency physicians, for benign paroxysmal positional vertigo in adults

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ABSTRACT

Objectives

This is a protocol for a Cochrane Review (intervention). The objectives are as follows:

To assess the effects of the Epley maneuver, performed by family doctors or emergency physicians, for adults with benign paroxysmal positional vertigo.

BACKGROUND

Frequently, vertigo is included in the general term 'dizziness'. Dizziness is a very common but imprecise reason for consultation, which represents more than three million visits to the emergency room per year (Palmeri 2023), and 5% of consultations in primary care (Patiño 2022; Post 2010). Dizziness (including vertigo) affects from 15% to over 20% of adults yearly in large population-based studies (Neuhauser 2016).

Vertigo is a subtype of dizziness defined as a sensation of rocking, tilting, turning, or imbalance, due to the perception of movement when none is occurring (Karatas 2008).

In 80% of cases, the origin of vertigo is vestibular or peripheral, meaning that in 20% of cases the cause is non-vestibular or central (Hung 2023). Vestibular vertigo accounts for about a quarter of dizziness complaints and has a 12-month prevalence of 5% and an annual incidence of 1.4%. Its prevalence rises with age and is about two to three times higher in women than in men (Neuhauser 2016).

More than 50% of cases of peripheral vertigo are classified as benign paroxysmal positional vertigo (BPPV), representing the most common cause (Palmeri 2023). However, this may be underestimated as BPPV is often misdiagnosed (Grill 2014; Kerber 2015). It is crucial to distinguish BPPV from other causes of vertigo, as there is a wide spectrum of conditions associated with vertigo, ranging from benign to life-threatening.

A retrospective analysis of people with BPPV in the USA revealed an incidence of 64 cases per 100,000 population annually (Froehling 1991), while a cross-sectional study found that the lifetime prevalence of BPPV was 2.4% (Von Brevern 2007). The one-year prevalence of BPPV increased with age and was seven times higher in those older than 60 years, compared with those aged 18 to 39 years (Von Brevern 2007). BPPV was more common in women than men in all age groups, with a reported ratio of 2:1 to 3:1 (Kim 2014; Von Brevern 2007). However, a large retrospective study exclusively on BPPV, conducted in India, mentions that BPPV affects men and women equally and is more prevalent in the age group of 40 to 60 years (Ghosh 2023).

Approximately 50% to 70% of BPPV cases occur without a known cause, and these are referred to as primary or idiopathic BPPV (Parnes 2009). Secondary BPPV occurs due to an underlying pathology (Maihoub 2020; Yetiser 2019), such as head trauma, vestibular neuronitis, labyrinthitis, Ménière's disease, migraine, ischemia, or iatrogenic causes (for example, utricular damage caused by inner ear surgery; Palmeri 2023).

In vulnerable populations such as the elderly, where the disease is more prevalent, very recent studies show that screening for BPPV in fall prevention units could diagnose and treat 25% of people with a 25% reduction in the waiting list of these units, including in asymptomatic people without any previous symptoms of vertigo (Hyland 2024; Metz 2024).

Description of the condition

Pathogenic mechanisms of BPPV

There are two pathogenic mechanisms of BPPV. The most frequent is canalolithiasis, characterized by free and detached otoconia (calcium carbonate material) migrating from the utricular macula into one or more semicircular canals filled with a viscous fluid (endolymph; Bhattacharyya 2017). The less frequent mechanism, cupulolithiasis, is characterized by otoconia attached to the cupula (Parnes 2009).

Affected semicircular canals

The posterior semicircular canal is the most frequently affected, accounting for 85% to 95% of BPPV cases; the lateral or horizontal semicircular canal is involved in 5% to 15% of cases; and the anterior semicircular canal is very rarely affected. Bilateral and even multichannel involvement is possible, although very rare (Bhattacharyya 2017; Parnes 2009).

BPPV caused by an affected posterior canal can be diagnosed in primary care by anamnesis, physical examination including neurological and auditory examination, and the Dix-Hallpike test (DHT), which is the gold standard for diagnosis (Ballvé 2019; Bhattacharyya 2017; Dix 1952). This test consists of a series of head movements and is considered positive when the typical symptoms of vertigo and a rapid and torsional nystagmus appear, with the upper pole of the eyes striking in the direction of the affected ear (Bhattacharyya 2017). Nystagmus is defined as an involuntary movement of the eyes that usually follows a rhythmic pattern (Kates 2021). A demonstration of DHT is available in a video prepared by Ballvé 2014a.

Typical clinical symptoms (vertigo) and signs (nystagmus)

The typical symptomatology of BPPV is a spinning sensation of oneself or the environment in the absence of true movement (Bösner 2018), characteristically of sudden onset, paroxysmal, and transitory, lasting less than one minute (Giardino 2021). It is usually triggered by changes in head position, for example, lying down, sitting, or turning over in bed (Bhattacharyya 2017; Giardino 2021). It may be associated with feeling faint, nausea or vomiting, sweating, skin pallor, and hypotension (Von Brevern 2007).

Nystagmus appearing on the DHT has two typical features: a latency period of about five to 20 seconds and fatigability within 60 seconds of onset (although repeating the maneuver to test for fatigability is not recommended). In cases of cupulolithiasis, the nystagmus may last for more than one minute. This nystagmus is a torsional and vertical movement (often described as horizonto-rotatory) that usually begins smoothly, increases in intensity, and then decreases as it resolves. When the person sits up, a nystagmus in the opposite direction may appear.

There are two types of nystagmus. Geotropic nystagmus is the most frequent and the one that beats more strongly towards the dependent (affected) ear. In these cases, calcium carbonate debris is found in the long arm of the semicircular canal. In contrast, apogeotropic type nystagmus is less frequent and the cephalic rotation test produces a horizontal nystagmus that beats towards the upper ear. In these cases, calcium carbonate debris is located adherent to the cupula (cupulolithiasis) or near the ampulla of the semicircular canal (Bhattacharyya 2017; Epley 1980; Parnes 2009).

Classification: objective and subjective BPPV

BPPV can be classified as objective or subjective (Huebner 2013). Objective BPPV has all of the above symptoms, whereas subjective BPPV has all symptoms without nystagmus. Some authors consider that the existence of vertigo symptoms without the occurrence of

nystagmus is sufficient for diagnosis; this is known as subjective BPPV (Haynes 2002), although the Bárány society designates it as possible benign paroxysmal positional vertigo (Von Brevern 2015). These cases account for 11.5% to 48% of all BPPV cases (Balatsouras 2012; Ballvé 2019; Von Brevern 2015).

Impact on quality of life

Carrillo and colleagues wrote that BPPV implies significant morbidity and has a high negative psychosocial impact on the person's quality of life. This is especially remarkable in women and people suffering subjective vertigo, who perceive their condition as a disability, according to scores on the Dizziness Handicap Inventory (DHI; Carrillo 2019). In addition, 86% of people affected by BPPV need medical consultation and must interrupt their daily and work activities due to illness (Von Brevern 2007). The consequences of undiagnosed or untreated BPPV also include worsening symptoms of depression, difficulty turning over in bed (Carrillo 2019), and increased risk of falling, especially in the elderly (Scherer 2012).

Description of the intervention

The Brandt-Daroff exercises (Brandt 1980), and the Epley and Semont canalicular repositioning maneuvers (Epley 1980; Epley 1992; Semont 1988), are the main therapies for BPPV (Hilton 2014), without serious adverse effects.

Currently, the Epley maneuver is the best known (Epley 1992), as it has been widely reported as being the most effective treatment for people with unilateral posterior semicircular canal BPPV (Ballvé 2019; Giardino 2021; Hilton 2014). This canalith repositioning maneuver was introduced by Dr. John Epley in response to the need for a non-invasive treatment for BPPV (Epley 1992).

The Epley maneuver usually lasts approximately five minutes and consists of a series of head movements aimed at repositioning the displaced otoliths. It is performed manually at the bedside, without the need for additional resources or equipment (Khoujah 2023). After confirming the diagnosis by DHT, the therapeutic Epley maneuver is performed by taking the person from sitting to supine, with a pillow placed under the shoulders so that the head tilts back an additional 30°. The head is then turned toward the affected side for one minute or until the nystagmus stops. The head is then turned 90° to the opposite side and held there for one minute. The person is then helped to turn their whole body in the direction that the head is facing, and the head is turned further in that direction to face towards the floor, where they should be kept for one minute. To complete the maneuver, the person returns to sitting. A demonstration of the Epley maneuver is available in a video prepared by Ballvé 2014b. The DHT can then be repeated to determine if the nystagmus has resolved, suggesting resolution of BPPV. If torsional nystagmus is present, the Epley maneuver is repeated once (Ghosh 2023). A prospective cohort study suggested that close repetition of a single Epley maneuver after a successful maneuver may reduce the risk of persistence and recurrence of BPPV (Nogi 2023). Therapeutic canalicular repositioning maneuvers are usually administered by expert otolaryngologists, although they can be performed in different healthcare settings in the context of routine practice by many appropriately trained healthcare professionals, such as physical therapists, family physicians, emergency physicians, and neurologists (Hilton 2014).

People affected by BPPV can be quickly identified and treated in primary care through the DHT and the Epley maneuver, respectively, without the need for hospital referral or expensive complementary tests (Patiño 2022). Clinical practice guidelines recommend these two maneuvers and advise against the use of anti-vertigo drugs and the use of complementary tests, except in the few cases in which the diagnosis is unclear. However, they should not be performed in cases of physical limitations including cervical stenosis, Down's syndrome, severe rheumatoid arthritis, cervical radiculopathies, Paget's disease, morbid obesity, ankylosing spondylitis, low back dysfunction, retinal detachment, carotid stenosis, and spinal cord injuries (Bhattacharyya 2017).

The repositioning maneuvers, the most studied of which is the Epley maneuver, achieve a resolution of symptoms in up to 80% of cases in the first consultation (Von 2006), and 92% with repetition (Gordon 2004; Kim 2021). In addition, this maneuver allows for an average reduction of 2.03 points on the DHI scale compared to control (sham maneuver; Carrillo 2019; Giardino 2021).

The Epley maneuver can be repeated up to four times weekly (Moreno 2009). However, referral to a more specialized service must be considered after the third attempt (Soto-Varela 2013). People with recurrent BPPV should be provided with a referral to an otorhinolaryngologist for further evaluation as there are lateral and horizontal canal variants of BPPV that require specific repositioning maneuvers different from the Epley maneuver (Palmeri 2023).

How the intervention might work

The Epley maneuver uses gravity to displace otoconial debris from the posterior semicircular canal back into the vestibular utricle, eliminating discomfort and symptomatology as the person moves successively through a series of head positions. The clinical response usually appears 24 to 48 hours after the maneuver is performed. These responses include both a negative result on the DHT (no nystagmus) and the subjective improvement of symptoms.

Therefore, and according to clinical practice guidelines (Bhattacharyya 2017), complementary tests (such as magnetic resonance imaging or computed tomography scan), pharmacological treatments, and referrals to specialized services are unnecessary. The performance of such maneuvers could lead to a reduction in the number of requests for the aforementioned complementary examinations, treatments, and referrals to other services. In addition, early treatment reduces recurrence rates and increases the probability of resolution (Khoujah 2023).

No serious adverse events have been associated with Epley maneuver in RCTs. However, feeling faint, nausea or vomiting, sweating, skin pallor, and hypotension were described in 6.9% of participants in one study (Yimtae 2003); another study described vomiting during treatment and difficulties tolerating the maneuver due to neck problems (Froehling 2000). Another possible complication of the treatment maneuvers for BPPV, which occurs in less than 5% of cases, is conversion to BPPV involving the horizontal canal (Herdman 1996). No adverse effects have been reported for the sham maneuver, which consists of resting for five minutes with the head tilted toward the affected side.

Why it is important to do this review

About 60% to 80% of persons with BPPV consult primary care and hospital emergency departments (Polensek 2008). The diagnosis

of 'non-specific dizziness' is prevalent and the performance of repositioning therapeutic maneuvers in these settings is rare (Dunlap 2019; Grill 2016; Patiño 2022; Wang 2014), with excessive use of unnecessary complementary tests, such as computed tomography and magnetic resonance imaging, as well as the misuse of pharmacological treatments (Edlow 2022; Munoz 2007). Therefore, for this practice to be adopted in primary care, there is a need for systematic training to improve otoneurology skills in primary care for the diagnosis and treatment of BPPV (Carrillo 2019; Grill 2014).

It should be noted, however, that some studies indicate that the Epley maneuver is less effective when performed by family physicians rather than experts. In a clinical trial conducted in Canada comparing Epley maneuver to sham, 81 participants with posterior canal BPPV attended two visits, one week apart, with a family doctor, in which both the intervention group and the control group underwent Epley maneuver (Munoz 2007). Three family doctors were involved in this study; one was also a neurologist while the other two received an hour-long training session on the Epley maneuver. Results showed that participants improved in terms of response to DHT, measured by the resolution of nystagmus, but not in the variable resolution of vertigo. Therefore, this trial did not demonstrate any subjective improvement in participant' symptoms. Another study obtained an improvement in the DHT response and in the severity of vertigo measured by the Likert scale, but only among those who had a visible nystagmus at the first visit (objective vertigo; Ballvé 2019). Another study of general practitioners achieved resolution of nystagmus following DHT and resolution of vertigo in 50% to 67% of cases in the intervention group and 19% to 38% of cases in the control group, by performing up to three maneuvers in each person (Froehling 2000), while studies carried out by experts achieved clinical resolution in 70% to 90% of cases (Hilton 2014).

There are no systematic reviews that address the benefit of Epley maneuver to treat BPPV performed by family physicians or emergency physicians in the setting of primary care and hospital emergency departments.

OBJECTIVES

To assess the effects of the Epley maneuver, performed by family doctors or emergency physicians, for adults with benign paroxysmal positional vertigo.

METHODS

Criteria for considering studies for this review

Types of studies

We will include randomized, parallel, controlled trials (RCTs) or cluster-RCTs. For cross-over trials, we will only include results from before the cross-over (first intervention period). We will include published and unpublished studies since 1992 (the year the Epley maneuver was developed), without language restrictions.

Our exclusion criteria are:

- publications without original research (e.g. reviews, editorials, letters to the editor, or systematic reviews);
- studies where the Epley maneuver is performed by specialized providers (e.g. otorhinolaryngology, neurology, etc.);
- quasi-experimental studies, which are defined as studies that estimate causal effects using variations in the variable of interest that are not directly controlled by the study author (e.g. interrupted time series studies, controlled before-and-after studies, difference-in-differences designs, and fixed-effect analyses of panel data; Rockers 2015) or non-standard randomization procedures (e.g. alternating enrollment, allocation based on date of birth, or assignment based on participant characteristics).

We expect to find enough studies to include in this systematic review. No studies will be excluded unnecessarily and, if necessary, the reasons for exclusion will be justified.

Types of participants

We will include participants 18 years of age or older, of any race or geographic location, presenting typical BPPV symptoms, diagnosed with objective and subjective/possible BPPV by means of positive DHT performed by family doctors or emergency physicians, in the primary care setting (consultations and emergencies) and hospital emergency departments.

If we identify studies that include participants under 18 years old, we will contact the authors to obtain separate data for adults. If we are unable to obtain adult-specific data, we will include the study if more than 50% of the participants are adults.

Types of interventions

The repositioning of otoconia from the posterior semicircular canal to the utricular macula, a critical element of the Epley maneuver, generally takes around five minutes. This procedure involves four sequential movements, starting with sitting, then lying down, turning, and finally returning to a seated position. These deliberate actions help move the otoconia, ensuring they become inert once they reach the utricular macula.

We will include studies of the Epley maneuver carried out at least once, in person and individually, by family doctors or emergency physicians, in the primary care setting (consultations and emergencies) and hospital emergency departments. The technique is feasible in all contexts; it does not depend on any specific equipment and only involves the use of a stretcher or a bed.

We will include all comparators (e.g. no treatment, placebo, or other active treatment). A common sham (placebo) maneuver consists of lying down with the head turned to the affected side for five minutes (Froehling 2000). Eligible comparators for 'other active treatment' may include vestibular rehabilitation and various repositioning maneuvers, such as the Semont maneuver or the Brandt-Daroff exercises, designed to reposition otoliths in the inner ear to alleviate symptoms. Additionally, vestibular suppressant drugs, such as betahistine or diazepam, although they do not directly address the underlying cause of BPPV, will be considered as active comparators.

If important co-interventions are not balanced across intervention and comparator groups, we will consider the potential risk of introduced bias. We will perform additional sensitivity analyses to determine if unbalanced co-interventions affect the outcomes, or we will apply regression models adjusted for the co-intervention. We will use transparent and cautious reporting, acknowledging the limitations in the interpretations.

We will not impose additional restrictions on interventions and comparators with respect to delivery, duration, or intensity.

Comparisons sought include:

- EM versus placebo (sham maneuver);
- EM versus untreated control;
- EM versus other active treatment.

Types of outcome measures

Primary outcomes

- Resolution (partial or complete) of clinical BPPV, reported by the participant, as measured by:
  - subjective resolution of vertigo (yes/no)
  - a Likert scale (1 representing 'Strongly Disagree,' 2 representing 'Disagree,' 3 representing 'Neutral' or 'Neither Agree nor Disagree,' 4 representing 'Agree,' and 5 representing 'Strongly Agree'; Likert 1932);
  - the DHI (with a maximum score of 100 – 28 points for physical, 36 points for emotional and 36 points for functional – and a minimum score of 0; Jacobson 1990); or
  - another validated scale, regardless of the time at which the outcome is measured (usually the short term is considered to be one week to one month, and the long term is considered to be a year).
- Adverse events of the Epley maneuver or other maneuvers, such as intolerance to the positioning maneuvers because of cervical problems.

If resolution of BPPV is measured on more than one scale, we will establish a hierarchy of scales, the first being subjective resolution of vertigo (yes/no), the second being the Likert scale, and the third being the DHI.

Secondary outcomes

- Negative result on the DHT measured by the absence of nystagmus during this maneuver observed by the study author.
- Use of complementary tests such as magnetic resonance imaging or computed tomography scan (yes versus no or the number for whom it was used in each group).
- Drug prescription such as betahistine or another vestibular suppressant or antihistamine drugs (e.g. sulpiride, proclorperazine).
- Referral to specialized care (e.g. otorhinolaryngology, neurology).

We will include eligible studies regardless of outcomes reported.

Search methods for identification of studies

We will conduct a search that is as extensive and exhaustive as possible, in order to ensure that we include as many relevant studies as possible in the review.

We designed the search strategy for this review in collaboration with a health librarian from the Faculty of Medicine of the University of Barcelona. The librarian played a key role in designing the initial search strategy and will continue to assist in adapting and translating the search for other databases as needed. The search strategy can be found in Appendix 1.

Electronic searches

We will search the following databases.

- MEDLINE databases via PubMed (1992 to search date)
- Embase via Ovid (1992 to search date)
- Cochrane Central Register of Controlled Trials (CENTRAL)
- CINAHL
- Web of Science or Scopus
- Unpublished ongoing or completed clinical trial registries such as ClinicalTrials.gov and the World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP)

We will adapt the MEDLINE search strategy in Appendix 1 for use in other databases.

We will not apply linguistic restrictions to the search strategy. We will begin our search in 1992, because that is the year in which the Epley maneuver was developed.

Where appropriate, we will use the highly sensitive search strategy designed by Cochrane for identifying randomized controlled trials and controlled clinical trials, as described in the *Cochrane Handbook for Systematic Reviews of Interventions,* Chapter 4 (Lefebvre 2024).

Searching other resources

We will search the following sources to collect as much relevant data as possible.

- Manual search in the reference lists of systematic reviews
- Manual search of specific journals for review: Journal of Vestibular Research; Ear and Hearing; Hearing Research
- Scientific Citation Index / Expanded Scientific Citation Index
- Free search on the web
- Gray literature: conference proceedings; doctoral theses; contact with researchers, authors, thematic specialists, and organizations; personal collections of articles

Prior to publication, we will search MEDLINE, Embase, and Retraction Watch (retractionwatch.com) to ensure that none of the included studies have been withdrawn owing to errors or fraud.

Data collection and analysis

Selection of studies

We will import the search results into reference management software, such as Mendeley Reference Manager, where we will eliminate duplicates. Two review authors (from TCV, YRM, GFM, JBM, and EPR) will independently examine the titles and abstracts to determine their suitability. In case of any discrepancies, a third review author from the above group (different from the initial performing pair) will intervene to resolve them.

We will retrieve the full-text articles for all eligible, potentially eligible, and unclear records. Two review authors (from TCV, YRM, GFM, JBM, and EPR) will then assess the articles against our eligibility criteria and document the reasons for excluding any ineligible studies. We will attempt to resolve disagreements by discussion; otherwise, a third review author from the group mentioned above (other than the initial performing pair) will intervene to resolve the disagreement.

We will report the study selection process using a PRISMA flow diagram (Page 2021).

At least two review authors (from TCV, YRM, GFM, JBM, and EPR) will extract data. Any disagreements will be resolved by discussion; if this fails, a third review author from the group mentioned above (other than the initial performing pair) will intervene to resolve the disagreement.

Data extraction and management

For each included study, at least two review authors (from TCV, YRM, GFM, JBM, and EPR) will independently extract data using a standardized collection form developed in Microsoft Excel, according to the criteria described in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2024a).

We will pilot the collection form with at least two included studies, extracting the following study characteristics.

- General information: first author, year of publication, and country
- Study characteristics: study design, setting, and period of study
- Participant characteristics: type of population, age, gender, and sample size
- Description of intervention and comparison intervention(s). We will describe interventions in detail using the template for intervention description and replication (TIDieR) tool (Hoffmann 2014). We will collect information on whether studies provide explicit details on the training provided to professionals in performing both diagnostic and therapeutic maneuvers, including evidence of training, appropriate use, and diagnostic accuracy. This information will then be used to conduct subgroup analyses to evaluate how variations in training and experience might affect intervention outcomes.
- Source of study funding, and any conflicts of interest reported by the study authors
- Outcome: definition of outcome and timing of measurement
- Results for each group
- Variables, in order to assess the risk of bias

If there is questionable or missing information in the articles, we will contact the study authors. In the absence of a response, we will work with the available data.

We will resolve any disagreements during the assessment process through discussion and, in case of any discrepancies, a third review author from the above group (different from the initial performing pair) will intervene to provide resolution.

Assessment of risk of bias in included studies

Two pairs of review authors (from TCV, YRM, GFM, JBM, and EPR) will independently evaluate the risk of bias for each included study using RoB 2 for parallel-group randomized trials (Sterne 2019). We will also use the RoB 2 specifically designed for cluster-randomized trials (Eldridge 2024). For cross-over trials, we will use the first period of the trial and apply the standard version of RoB 2 for parallel group randomized trials.

We will employ RoB 2 in order to evaluate the risk of bias for each primary outcome across five domains.

- Bias arising from the randomization process (selection bias)
- Bias due to deviations from the intended interventions (performance bias)
- Bias due to missing outcome data (attrition bias)
- Bias in the measurement of the outcome (detection bias)
- Bias in the selection of the reported result (reporting bias)

For each domain, specific signaling questions will be answered, leading to a judgment of the risk of bias using the RoB 2 algorithms (yes, probably yes, probably no, no, or no information; https://www.riskofbias.info/welcome/rob-2-0-tool).

In this review, we will assess the effect of assignment to the intervention at baseline (intention-to-treat effect). This means that the analysis will include all participants as they were originally randomized, regardless of whether they received or followed the interventions as intended.

This will be the approach for assessing our primary outcomes, as recommended by the *Cochrane Handbook* (Lefebvre 2024), and will provide an estimate of the effect of assignment to the intervention at baseline, which we consider most appropriate for the objectives of the review.

The next step will be to reach a possible risk of bias judgment, and we will assign one of three levels.

- Low risk of bias when the trial is judged to be at low risk of bias for all domains for this result.
- Some concerns when the trial is judged to raise some concerns in at least one domain for this result, but not to be at high risk of bias for any domain.
- High risk of bias when the trial is judged to have some concerns for multiple domains in a way that substantially lowers confidence in the result or or when it is judged to be at high risk of bias in one domain. In such cases, the overall risk of bias will be rated as high.

We will use the RoB 2 tool to assess the risk of bias for the following key outcome measures.

- Subjective resolution of vertigo (yes/no) at one week, one month, and one year.
- Severity of vertigo measured using the Likert scale at one week, one month, and one year.
- DHI results at one week, one month, and one year.
- Resource use outcomes, including complementary tests (yes/no) and referrals to specialists (yes/no).
- Safety outcomes, specifically side effects of drugs and other therapies (yes/no).

We have selected these outcomes as they represent the most important measures for evaluating the effects of the Epley maneuver, and we will prioritize them in the summary of findings tables.

We will include all available studies and perform a sensitivity analysis. We will present the results of each study in a forest plot, stratifying the analysis based on the risk of bias.

We will resolve any disagreements during the assessment of risk of bias in the included studies by discussion and, in case of

discrepancies, a third review author (from TCV, YRM, GFM, JBM, and EPR), different from the initial performing pair, will intervene to resolve them.

Measures of treatment effect

We will employ two summary statistics for continuous data. Mean differences (MDs) with 95% confidence intervals (CIs) will be calculated if all studies utilize the same measurement tool for the outcome. When different scales are used to assess the same outcome across studies, we will employ standardized mean differences (SMDs) with 95% CIs. We will determine the SMD using Hedges' g, which incorporates a pooled standard deviation (SD) in the denominator calculated from the intervention group data under the assumption of similar SDs in both groups (Higgins 2024b). We will interpret an SMD of 0.2 as a small effect, 0.5 as a moderate effect, and 0.8 as a large effect (Schünemann 2024).

For binary variables, we will pool the relative risk ratios (RRs) and 95% CIs. Additionally, we will utilize the hazard ratio with a 95% CI as the effect size for the time-to-event outcome.

We will estimate 95% CIs and two-sided P values for each outcome and calculate prediction intervals for the primary pooled results.

Unit of analysis issues

In each study, we will take into account whether:

- groups of individuals were randomized to the same intervention (e.g. cluster-randomized trials);
- individuals received more than one intervention (e.g. in a cross-over trial, or simultaneous treatments on each individual);
- there are multiple observations for the same outcome (e.g. repeated measurements, recurrent events, measurements on different parts of the body).

We will conduct the analysis at the level of randomization. For trials with multiple intervention groups, we will group these together to form a single pairwise comparison.

For cluster-RCTs, the unit of analysis will be the cluster. We will assess whether study authors have adjusted for clustering and how this adjustment has affected the overall results. If clustering has minimal impact, we will use unadjusted data. However, if clustering significantly impacts the results, we will adjust for it using the intraclass correlation coefficient (ICC), where reported. If ICC estimates are not provided, we will request them from the authors or impute them based on ICCs from other cluster-RCTs included in the review. Additionally, we will adjust the standard errors of effect estimates using the design effect to account for clustering. The design effect is calculated as 1 + (M−1) × ICC1 + (M − 1) \ times ICC1 + (M−1) × ICC, where M represents the average cluster size and ICC is the intraclass correlation coefficient. We will use the generic inverse-variance method for the meta-analysis.

Dealing with missing data

To deal with the different data formats and missing statistics, we will contact study authors to ask for missing outcome data. If we are unable to obtain data from the study authors, we will compute data with several approaches. For example, if a study reports median, range, and sample size, we will obtain mean and variance using the method developed by Hozo (Hozo 2005); or in case of missing standard deviation, we will impute from CI, standard errors, t-values, P values or F values according to the methods recommended in the *Cochrane Handbook* (Higgins 2024b).

Assessment of heterogeneity

To investigate potential heterogeneity, we will employ visual inspection of the forest plot and calculation of the I^2 statistic and the Chi^2 test. If our analysis reveals substantial heterogeneity ($I^2 \geq 50\%$; Higgins 2003), we will explore potential reasons by examining the characteristics of individual studies and conducting subgroup analyses and meta-regression when feasible. Meta-regression will be conducted by utilizing the 'metareg' macro, which is included in the Stata statistical package (Stata).

Assessment of reporting biases

To analyze a possible reporting bias, we will perform the following steps.

- Compare the study protocol or registry with the published report.
- Contact the authors to verify all outcomes measured.
- Consider the possible involvement of commercial interests in the study.
- Examine the asymmetry of the funnel plot.

We will reduce the risk of reporting bias by:

- an exhaustive literature search (published and unpublished trials), including contacting experts and researchers in the field;
- funnel plots for meta-analyses with more than 10 studies and where the included studies are of different sizes.

Data synthesis

We will carry out a structured, qualitative (narrative) synthesis of findings of the included studies on the characteristics of the target population, the type and content of the intervention, the comparator, and the type of result, using the Synthesis Without Meta-analysis (SWiM) guidance (McKenzie 2019).

We will present summary of findings tables to organize and summarize the results, along with the GRADE assessments for each of the outcomes (Schünemann 2024).

Subgroup analysis and investigation of heterogeneity

When there are enough studies available (a minimum of two), we will conduct the following subgroup analyses, which may also introduce clinical heterogeneity.

- Sex (women versus men, because vertigo occurs about two to three times more often in women than in men; Neuhauser 2016).
- Age (divided into two categories: less than 60 years and 60 years or older, as the prevalence in people aged over 60 years is seven times greater than in those aged between 18 and 39 years; Von Brevern 2007).
- Level of training and experience of professionals. We will categorize studies based on:
  - whether explicit training protocols for diagnostic and therapeutic maneuvers are reported;
  - evidence of training adequacy, such as validated training programs or certifications;

- diagnostic accuracy assessed and reported.

We will employ the formal test for subgroup differences in RevMan 2025 to compare the subgroups.

Sensitivity analysis

We will perform sensitivity analyses with the following characteristics.

- High/unclear risk of bias
- Study design (RCTs vs other designs)
- Imputed data

Summary of findings and assessment of the certainty of the evidence

We will interpret statistical results using CI interpretation and SMD interpretation.

We will construct summary of findings tables using the GRADE approach (GRADEpro GDT; Deeks 2024; Schünemann 2024). This will provide recommendations that incorporate the relevance, applicability, and certainty of the evidence from this review (Santesso 2020).

In the summary of findings tables, we will include the most relevant outcomes to provide a comprehensive overview of the evidence regarding Epley maneuver versus no treatment, placebo, pharmacological treatments, vestibular rehabilitation, and other maneuvers. The key elements will be:

- subjective symptom resolution: vertigo resolution (yes/no);
- DHT result: resolution of nystagmus (yes/no);
- resource use outcomes:
  - complementary tests (yes/no)
  - referrals to specialists (yes/no);
- safety outcomes: side effects of drugs and other therapies (yes/no).

We will include these prioritized outcomes in the summary of findings tables to ensure a focused and clear presentation of the evidence regarding the Epley maneuver and its comparisons.

We will evaluate the evidence for factors that reduce its certainty, including study limitations (risk of bias), inconsistency of results, indirect evidence, imprecision, and publication bias. Specifically, for imprecision, we will consider both the optimal information size and the review information size. If the 95% CI excludes any effect, or a small less than clinically important effect (< 15% relative change), or both, we will downgrade the evidence for imprecision, even if the optimal information size criterion were met (Schünemann 2024).

Finally, we will assess the level of confidence in the evidence using the GRADE approach, which includes the following categories: high, moderate, low, and very low. In the high category, we are very confident that the true effect is close to the effect estimate. In the moderate category, we have moderate confidence in the effect estimate, as the true effect is likely to be close to the effect estimate, but there is a possibility that it could be substantially different. In the low category, our confidence in the effect estimate is limited, as the true effect may be substantially different from the effect estimate. In the very low category, we have very low confidence in the estimate of effect, as the true effect is likely to be substantially different from the estimate of effect. We will use the 'overall' risk of bias to assess the certainty of the evidence.

Two review authors (from TCV, YRM, GFM, JBM, and EPR) will independently perform the GRADE assessment and reach agreement by consensus.

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- Sign-off Editor (final editorial decision): Richard Rosenfeld, Distinguished Professor of Otolaryngology, SUNY Downstate Health Sciences University, Brooklyn, NY, USA.
- Managing Editor (conducted editorial policy checks, selected peer reviewers, collated peer-reviewer comments, provided editorial guidance to authors, edited the article): Hannah Payne, Cochrane Central Editorial Service.
- Copy Editors (copy editing and production): Carolyn Wayne, Cochrane Central Production Service; Jordi Cornet Hernando, User Training Service, Bellvitge Campus Library, Learning and Research Resources Center of the University of Barcelona.

The following people conducted peer-review for this article (provided comments and recommended an editorial decision)

- Dimitrios Balatsouras, MD, PhD, Director of the Audiology-Neurotology Department of Tzaneion General Hospital of Pireaus, Greece (clinical/content review).
- Brian Duncan (consumer review).
- Clare Miles, Cochrane Evidence Production and Methods Directorate (methods review).
- Jo Platt, Cochrane Evidence Production and Methods Directorate (search review).
- One additional peer reviewer provided clinical/content peer review but chose not to be publicly acknowledged.

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APPENDICES

Appendix 1. Search strategy, for the question of Epley maneuver, performed by family doctors or emergency physicians, for benign paroxysmal positional vertigo in adults, used via MEDLINE.

1. ("Benign Paroxysmal Positional Vertigo"[Mesh]

2. ("Benign Paroxysmal Positioning Vertigo" OR "Peripheral Vertigo" OR "Positional vertigo" OR "Paroxysmal vertigo" OR "Paroxysmal positional vertigo" OR "Benign positional vertigo" OR "Benign paroxysmal vertigo" OR "Idiopathic benign paroxysmal positional vertigo" OR "Rotational vertigo" OR VPPB OR BPPV).mp.

3."Vertigo"[Mesh]

4."dizziness"[Mesh]

5. (vertig* or dizziness OR vestibulopath* OR Canalolithiasis OR Canalithiasis OR Cupulolithiasis OR paroxysmal).mp.

6. 1 or 2 or 3 or 4 or 5

7. ("Canalith repositioning" OR "canalith repositioning procedure" OR "Canalith repositioning maneuver" OR" Canalith repositioning manoeuvre" OR "Epley Maneuver" OR "Epley's Maneuver" OR "Epley Manoeuvre" OR "Epley's Manoeuvre" OR "Epley Procedure" OR "Epley CRM" OR "Epley M" OR "Modified Epley's procedure" OR "Modified Epley procedure" OR "Modified Epley maneuver" OR "Repositioning maneuver" OR "Repositioning manoeuvre" OR Epley repositioning maneuver).mp.

8. (epley* OR canalith* OR otolith* OR particle OR position* OR reposition* OR maneuver* OR manoeuvr*).mp.

9. "head movements"[Mesh]

10. "physical therapy modalities"[Mesh]

11. 7 or 8 or 9 or 10

12. 6 AND 11 AND (1992:2024[pdat]) AND (alladult[Filter]) AND ((randomized controlled trial[Filter])

CONTRIBUTIONS OF AUTHORS

TCV, EPR, JBM were responsible for conceptualization.

TCV, YRM, JBM were responsible for methodology.

TCV, YRM, JBM were responsible for writing – original draft.

TCV, YRM, JBM, EPR, GFM were responsible for review and editing.

TCV, YRM, GFM were responsible for designing the search strategies.

All authors will approve the final version for publication.

DECLARATIONS OF INTEREST

TCV, YRM, JBM and EPR declare that we are part of VERTAP, a new emerging multidisciplinary research group, certified by IDIAP Jordi Gol, composed of family physicians, otolaryngologists, physiotherapists and statisticians, whose main objective is to improve the clinical management of vertigo in Primary Care in Cataluña, Spain.

JBM and YRM were involved in the conduct of eligible studies – "Effectiveness of the Epley manoeuvre in posterior canal benign paroxysmal positional vertigo: a randomized clinical trial in primary care" and "A single Epley manoeuvre can improve self-perceptions of disability (quality of life) in patients with pc-BPPV: A randomized controlled trial in primary care" – and will therefore not be involved with study selection, data extraction and management, RoB assessments, and GRADE assessments for these studies.

GFM has declared no conflict of interest.

SOURCES OF SUPPORT

Internal sources

- New Source of support, Other

  None

External sources

- New Source of support, Other

  None