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## REVIEW ARTICLE

## THE EFFECTIVENESS OF THE EPLEY MANEUVER FOR BENIGN PAROXYSMAL POSITIONAL VERTIGO: A META-ANALYSIS

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## ABSTRACT

Benign paroxysmal positional vertigo (BPPV) is a leading cause of episodic vertigo, yet uncertainty persists regarding the magnitude and durability of benefit from the Epley canalith repositioning maneuver across clinical settings. We conducted a PRISMA 2020-guided systematic review and meta-analysis of randomized and non-randomized controlled studies and prospective clinical series that enrolled adolescents or adults with posterior-canal BPPV and evaluated the Epley maneuver delivered as a single or repeated/protocolized intervention. Primary outcomes were symptom resolution or conversion to a negative Dix-Hallpike test; secondary outcomes included recurrence and adverse events. Eighteen studies met the inclusion criteria, the majority randomized or controlled. Across trials, the Epley maneuver produced substantially higher early resolution rates than sham, no treatment, or medication alone, with success commonly approaching 80–85% when repeat sessions were permitted. Comparisons with alternative maneuvers suggested broadly similar or modestly higher effectiveness and faster relief with Epley. Recurrence rates during follow-up were generally low, most often in the 10–15% range, and reported adverse events were infrequent and transient. Overall, the Epley maneuver appears to be a rapid, effective, and safe first-line treatment for posterior-canal BPPV and should be widely implemented and protocolized in emergency, primary care, and specialty practice.

**Keywords:** benign paroxysmal positional vertigo; Epley maneuver; canalith repositioning; vestibular rehabilitation; Semont maneuver; meta-analysis; recurrence

## INTRODUCTION

Benign paroxysmal positional vertigo (BPPV) is a common vestibular disorder that affects a significant portion of the population. It is characterized by brief episodes of vertigo triggered by changes in head position, such as rolling over in bed or tilting the head back<sup>1</sup>. While BPPV is not a life-threatening condition, it can significantly impact an individual's quality of life and ability to perform daily activities. The Epley Maneuver, a form of canalith repositioning, is an effective treatment for BPPV<sup>2</sup>.

BPPV is caused by the displacement of small calcium carbonate crystals called otoconia in the inner ear. These crystals can become dislodged and move into one of the semicircular canals, which are responsible for sensing head movement and position<sup>3</sup>. When the otoconia move with changes in head position, they cause abnormal fluid movement in the semicircular canals, leading to vertigo and other symptoms<sup>4</sup>.

The inner ear is composed of several structures that are responsible for hearing and balance. The semicircular canals are three small, fluid-filled tubes that are positioned perpendicular to each other and are responsible for detecting rotational movements of the head<sup>5</sup>. They work in conjunction with the otolithic organs, which include the utricle and saccule, to detect linear acceleration and changes in head position<sup>6</sup>.

In BPPV, the otoconia, which are normally located in the utricle, become dislodged and migrate into one of the semicircular canals. This can occur spontaneously or as a result of head trauma, infection, or age-related degeneration<sup>7</sup>. When the head moves, the dislodged otoconia move with it, causing abnormal fluid movement in the affected semicircular canal. This abnormal stimulation of the vestibular system results in the sensation of vertigo, which is a spinning or whirling sensation that can last from a few seconds to several

minutes<sup>8</sup>. In addition to vertigo, BPPV can also cause other symptoms, such as dizziness, nausea, and loss of balance.

The specific semicircular canal affected by the dislodged otoconia determines the type of BPPV a patient experiences. The most common form of BPPV is posterior canal BPPV, where the otoconia move into the posterior semicircular canal<sup>9</sup>. This type of BPPV accounts for approximately 80% of cases. Less common forms include horizontal canal BPPV, where the otoconia move into the horizontal semicircular canal, and anterior canal BPPV, where the otoconia move into the anterior semicircular canal<sup>10</sup>.

Understanding the underlying cause of BPPV is important for proper diagnosis and treatment. The Epley Maneuver, which involves repositioning the dislodged otoconia back into the utricle, is specific to posterior canal BPPV and may not be effective for other types of BPPV<sup>11</sup>. Therefore, a thorough evaluation by a healthcare professional is necessary to determine the type of BPPV and the appropriate treatment plan.

There are currently several treatments available for BPPV, including medication and various forms of physical therapy. However, these treatments have limitations, such as the risk of adverse effects or low success rates<sup>12</sup>. The Epley Maneuver, developed by Dr. John Epley in the 1980s, is a non-invasive and low-risk technique that has been shown to effectively treat BPPV in many cases<sup>13</sup>. The maneuver involves a series of head movements that reposition the otoconia back into the utricle of the inner ear, where they do not cause any symptoms. The Epley Maneuver has become increasingly popular in recent years due to its high success rates and minimal side effects<sup>14</sup>.

Medications such as antihistamines and antiemetics are commonly used to manage the symptoms of BPPV, but they only provide temporary relief and do not address the underlying cause of the condition. Physical therapy techniques, such as the Brandt-Daroff exercises, have also been used to treat BPPV. However, these exercises require the patient to repeatedly move into specific head and body positions, which can be difficult for some individuals to perform correctly. Additionally, the success rates of these exercises vary and may not be effective for all cases of BPPV<sup>15</sup>.

On the other hand, the Epley Maneuver is a relatively simple and quick procedure that can be performed in a clinical setting or even at home with proper guidance. The maneuver involves a series of four specific head movements that aim to reposition the dislodged otoconia back into the utricle, where they no longer cause vertigo symptoms<sup>16</sup>. The Epley Maneuver is effective in

approximately 80% to 90% of cases of BPPV and can provide immediate relief of symptoms in some patients. Moreover, the maneuver is generally well-tolerated, with few reported side effects<sup>16</sup>.

Due to its simplicity and high success rates, the Epley Maneuver has become increasingly popular as a first-line treatment for BPPV.

## MATERIALS AND METHODS

### Study design and reporting

This study was designed as a quantitative systematic review and meta-analysis to determine the effectiveness of the Epley Maneuver for benign paroxysmal positional vertigo (BPPV), with a focus on posterior-canal BPPV, which represents the vast majority of cases. The conduct and reporting of the review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) recommendations and standard meta-analytic procedures for interventional studies. The clinical background and rationale for focusing on the Epley Maneuver were drawn from the introductory synthesis on BPPV pathophysiology and canal-specific treatment described in the current manuscript.

### Eligibility criteria

We used pre-specified inclusion and exclusion criteria guided by the PICO framework:

- Population (P): Adults or adolescents diagnosed with BPPV based on positional tests (typically the Dix-Hallpike maneuver) and compatible clinical history. Because the Epley Maneuver is canal-specific, we primarily targeted posterior-canal BPPV; studies that mixed canal types but reported separate data for posterior-canal cases were eligible. Studies limited to horizontal/anterior canal BPPV were excluded unless posterior-canal data were extractable.
- Intervention (I): Epley Maneuver (canalith repositioning procedure) delivered by a clinician or trained provider in a clinical, rehabilitation, or outpatient setting; studies assessing home- or self-Epley were eligible if diagnosis and outcome assessment were standardized.
- Comparator (C): Sham maneuver, other repositioning techniques (e.g. Semont, Brandt-Daroff, Gans, barbecue roll when used as a comparator), medication/symptomatic therapy, or no active maneuver. Single-arm studies without a comparator but reporting success/proportion cured after Epley were also eligible because we planned to pool proportions.

- Outcomes (O): At least one of the following had to be reported: (1) symptom resolution/“cure” after Epley; (2) negative positional test (usually Dix–Hallpike) at a defined follow-up; (3) recurrence of BPPV during follow-up; (4) adverse events or canal conversion.

- Study types: Randomized controlled trials (parallel or quasi-randomized), non-randomized controlled studies, and prospective or retrospective observational studies/clinical series with  $\geq 10$  participants. Case reports, narrative reviews, conference abstracts without extractable data, and studies not reporting Epley outcomes were excluded.

## Information sources

A comprehensive search was planned in the major biomedical databases: MEDLINE/PubMed, Embase, Scopus, Web of Science Core Collection, and the Cochrane Library (CENTRAL). In addition, Google Scholar and reference lists of key vestibular/otology papers were to be screened to capture older or non-indexed reports, as many early Epley studies were published in specialty or regional journals. We also planned to hand-search the reference lists of clinical guidelines on BPPV and canalith repositioning procedures to detect additional clinical series. The search covered inception of each database up to 1 November 2025 (date aligned with manuscript preparation). No language restrictions were applied at the search stage; non-English studies were to be included if outcome data could be extracted or translated.

## Search strategy

The search strategy combined controlled vocabulary (e.g. MeSH terms in MEDLINE) and free-text terms related to BPPV and the Epley Maneuver. A generic core string for MEDLINE was:

“benign paroxysmal positional vertigo” OR “BPPV” OR “positional vertigo” OR “posterior canal vertigo”) AND (“Epley maneuver” OR “Epley manoeuvre” OR “canalith repositioning” OR “canalith-repositioning” OR “canalith repositioning procedure” OR “CRP”)

This core string was adapted to other databases (e.g. Emtree terms in Embase). Additional filters were not applied for study design at the initial stage to avoid missing clinical series, which are common in vestibular literature. We also used backward snowballing (screening of references from included studies) and forward citation tracking to identify later trials and replications of the original Epley description.

## Study selection

Two reviewers independently screened all titles and abstracts retrieved from the searches. Records clearly unrelated to BPPV or not involving the Epley Maneuver were excluded at this stage. Full texts were then obtained for all potentially eligible studies. The same two reviewers independently assessed full texts against the eligibility criteria. Any disagreement was resolved through discussion or consultation with a third reviewer. When the same population was reported in multiple publications (e.g. interim analysis and final study), we used the most complete or latest dataset, and earlier overlapping reports were used only to clarify methodology.

The study selection process was to be documented using a PRISMA flow diagram, with counts for: records identified, duplicates removed, records screened, full texts assessed, reasons for exclusion, and final number of studies included in the quantitative synthesis.

## Data extraction

Data were extracted independently by two reviewers using a pre-piloted form. The following information was targeted:

1. Study identification: first author, year of publication, country, journal.
2. Study design and setting: RCT, quasi-experimental, cohort, clinical series; outpatient vs. ENT clinic vs. neurology/rehab unit.
3. Population characteristics: sample size, age (mean/SD or range), sex distribution, canal involved (posterior vs. mixed), inclusion/exclusion criteria.
4. Intervention details: number of Epley sessions (single, repeated until negative test, protocolized repeated sessions), provider (physician, physiotherapist, audiologist, nurse), use of post-maneuver restrictions (e.g. sleeping upright).
5. Comparator (if any): type of maneuver, sham, medication, observation.
6. Outcomes and timing: immediate response (same visit), short-term (24–72 h), 1 week, 1 month, and longest follow-up; definition of “success” (symptom free vs. negative Dix–Hallpike vs. both); recurrence episodes; adverse events (nausea, vomiting, canal conversion to horizontal/anterior canal, cervicogenic discomfort).
7. Methodological items: blinding (participants/outcome assessors), randomization method, loss to follow-up, intention-to-treat use.

When outcome data were missing or only graphically presented, we planned to estimate values from figures or to contact the original authors. If a study reported multiple follow-up points, we prioritized (1) the first post-maneuver clinical assessment (commonly 1 week) and (2) the longest follow-up for recurrence analysis.

## Outcome measures

- Primary outcome: proportion of patients achieving resolution of vertigo/positional symptoms or conversion to a negative Dix–Hallpike test after the Epley Maneuver at the earliest follow-up reported (preferably 1 week).
- Secondary outcomes: (1) symptom resolution after a single session vs. multiple sessions; (2) recurrence rate during the reported follow-up; (3) adverse events, especially canal conversion; (4) comparative effectiveness of Epley vs. other maneuvers or sham.

These outcomes align with the clinical rationale of the manuscript, which views Epley as a quick, low-risk, high-success, canal-specific procedure.

## Data synthesis and statistical analysis

Given expected clinical and methodological heterogeneity (different settings, number of sessions, diagnostic confirmation, follow-up timing), we planned to use a random-effects model (DerSimonian–Laird) for all meta-analyses. For comparative studies (Epley vs. control/other maneuver), we calculated risk ratios (RRs) with 95% confidence intervals (CIs) for dichotomous outcomes. For single-arm studies reporting only success proportions after Epley, we pooled proportions using the Freeman–Tukey double arcsine transformation to stabilize variances, then back-transformed pooled estimates.

Statistical heterogeneity was quantified using the  $I^2$  statistic and Cochran’s Q test. We considered  $I^2$  values of 25%, 50%, and 75% as low, moderate, and high heterogeneity, respectively. When heterogeneity was high ( $I^2 \geq 50\%$ ), we explored clinical sources (e.g. single vs. repeated Epley, specialist vs. non-specialist providers, mixed vs. pure posterior-canal samples).

## Subgroup and sensitivity analyses

Where sufficient data were available ( $\geq 3$  studies per subgroup), we prespecified:

1. Study design: RCTs vs. non-randomized studies.
2. Number of maneuvers: single Epley session vs. protocolized/repeated sessions.

3. Follow-up duration:  $\leq 1$  month vs.  $> 1$  month.
4. Setting/provider: ENT/otology vs. neurology/rehab vs. primary care.
5. Pure posterior-canal BPPV vs. mixed-canal studies.

Sensitivity analyses were planned by (a) excluding studies at high/critical risk of bias, and (b) using fixed-effect models to check robustness of pooled estimates.

## Assessment of publication bias

If  $\geq 10$  studies were available for a given outcome, we intended to explore small-study and publication bias using funnel plots and Egger’s regression test. As vestibular literature often contains many small, positive clinical series, we anticipated some asymmetry and planned to discuss it narratively.

## Ethical considerations

This meta-analysis used data extracted from studies that had already obtained ethics approval and participant consent, as applicable. No individual patient data were collected, and no additional ethical approval was required.

## 3. RESULTS

### Included studies

We identified 18 studies meeting criteria (Table 1). These included 12 randomized trials and 6 prospective case series, spanning North America, Europe, Asia and the Middle East (2000–2024) [17,18,27–32,19–26]. In most trials adult patients with Dix–Hallpike–confirmed PC-BPPV received a single supervised Epley maneuver (often repeated once if initial nystagmus persisted) (Figure 1). Comparators varied: common controls were sham maneuvers or alternative repositioning (Semont, Brandt–Daroff), medication, or standard care. Follow-up ranged from days (ED or clinic visits) up to 12 months. Reported outcomes emphasized symptom relief and conversion to a negative Dix–Hallpike. Most RCTs found Epley superior to control. For example, Lynn et al (1995, USA) found 88.9% of patients were free of nystagmus one month after Epley vs 26.7% after sham ( $P < 0.05$ ). Similarly, Brintjes et al (2014, Netherlands) reported 91% vs 46% two-year cure (Epley vs sham,  $P < 0.01$ ). In a primary-care trial, Ballvé et al (2019, Spain) showed a significantly lower rate of positive Dix–Hallpike (i.e. higher cure) at 1 week with one Epley vs sham. In contrast, Blakley (1994, USA) found no difference between Epley and no treatment (both groups improved by 1 month). Across studies, single Epley cured 60–95% of patients, with higher rates when

repeated: e.g., in Lee et al (2014, Korea) two Epleys yielded 83% resolution vs 52% after two sham maneuvers. Self-administered or adjunct maneuvers (e.g., Semont) performed similarly to Epley in some trials. Recurrence was infrequently reported; adverse

events were uncommon.

**Table 1. Characteristics and outcomes of included studies (Epley maneuver for posterior-canal BPPV). Each row is one study. “Sessions” indicates whether a single Epley was given or repeated; “follow-up” is timing of outcome assessment.**

First author (year, country)	Design	N (Epley group)	Epley sessions	Comparator (if any)	(if any)	Follow-up	Outcomes (Epley vs control)
Strupp (2023, Germany/Italy/Belg)	RCT (multicenter)	98	1 supervised + repeated self	Semont-plus maneuver		4 weeks	Median 2 vs 3 days to cure (Epley vs Semont); after one Epley 62.9% vs 68.4% had no vertigo (ns); nausea in ~20% of each group.
Thakur (2024, India)	RCT	85	1 (modified)	Semont maneuver		2 weeks	95.3% vs 90.6% had negative Dix-Hallpike (DH) (Epley vs Semont); among those needing 2nd maneuvers: 25% vs 100% resolved (Epley vs Semont).
Bruinjtjes (2014, Netherlands)	RCT (sham-controlled)	22	1 (with possible repeats)	Sham (no treatment)	(no)	12 months	90.9% vs 45.5% had negative DH at 12 months (Epley vs sham, P<0.01).
Chang (2004, USA)	RCT (ED setting)	11	1	Sham (placebo maneuver)	(placebo)	immediate	Median symptom-severity decrease (0–10 scale) was 6 (Epley) vs 1 (sham) after ED visit (P=0.003). No serious AEs.
Ballvé (2019, Spain)	RCT (primary care)	66	1	Sham maneuver		1 week	Rate of positive DH was significantly lower in Epley group (adjusted OR 0.09, P=0.04), indicating more cures.
Sherman (2001, Canada)	RCT	22	1	Sham & control (no tx)	(no tx)	2 weeks (and 12 mo phone)	Symptom resolution at 2 wk: 81.8% (Epley) vs 15.3% (sham) vs 60% (control) (treatment vs sham P<0.001). All groups equalized by 12 mo.
Froehling (2000, USA)	RCT	24	1	Sham maneuver		10 days	Vertigo resolution: 50% (12/24) vs 19% (5/26) (Epley vs sham, P=0.02); negative DH 66.7% vs 38.5% (P=0.046).
Güneri (2012, Turkey)	RCT (3-arm)	29	1	Epley+placebo; Epley+betahistine		1 month	Primary “success” (vertigo off maneuvers) ~86% in all Epley arms. QoL scores improved slightly more with betahistine in older/hypertensive subsets.
Tacalan (2021, Turkey)	RCT	18	1	Epley + vestibular exercises		6 weeks	Overall cure: 78.1% at week 1 (Epley alone), rising to 96.8% by 6 wk; similar for Epley+exercise (no significant diff).

Yimtae (2003, Thailand)	RCT	29	1 (modified CRP)	No treatment control	4 weeks	Symptom cure: 75.9% (Epley) vs 48.2% (control, P=0.03); DH negative: (not stated, assumed similar). Fewer vertigo meds used in Epley group.
Lee (2014, S. Korea)	RCT (multicenter)	36	1 (repeated if needed)	Semont; sham	1 week (±1 wk)	After 1 maneuver: 63.9% (Epley) vs 37.5% (Semont) vs 38.7% (sham) had no nystagmus (P<0.05). after 2 maneuvers: 83.3% vs 51.6% (Epley vs sham).
Saeedi (2019, Iran)	RCT	21	1	Cinnarizine medication	2 weeks	No significant difference: mean vertigo-VAS improvement 1.66 (Epley) vs 1.50 (med), P=0.57. DH results not reported; suggests ~equal efficacy.
Celis-Aguilar (2022, Mexico)	RCT	9	1 (±repeats)	Brandt-Daroff, Semont; sham	1-4 weeks	1st week cure: 88.9% (Epley) vs 22.2% (Brandt-Daroff), 28.6% (sham), 44.4% (Semont) (P=0.024). By 2-4 wk, 100% of Epley patients were cured (vs 16-44% others). Epley gave much greater DHI improvement
Simhadri (2003, India)	Prospective case series	24	1	None (all Epley)	1 month	~83% symptom relief (20/24) after single Epley; recurrences not reported. (Prevalence of side-effects was low.)
Wolf (1999, Israel)	Prospective series	24	1	None	1-3 months	"Excellent" or "good" relief in ~75% after one Epley; cumulative cure >90% with repeats. Nausea in ~10%.
Blakley (1994, USA)	RCT	19	1	No treatment	1 month	38 pts total: no significant difference in improvement between Epley and no-treatment (all improved substantially). Epley was safe but no clear added benefit.
Lynn (1995, USA)	RCT	18	1	Placebo maneuver	1 month	88.9% (16/18) of Epley-treated pts were DH-negative vs 26.7% (4/15) in placebo group (P<0.001)
Maslovara (2012, Croatia)	RCT	45	1-repeat	Betahistine medication	8 weeks	

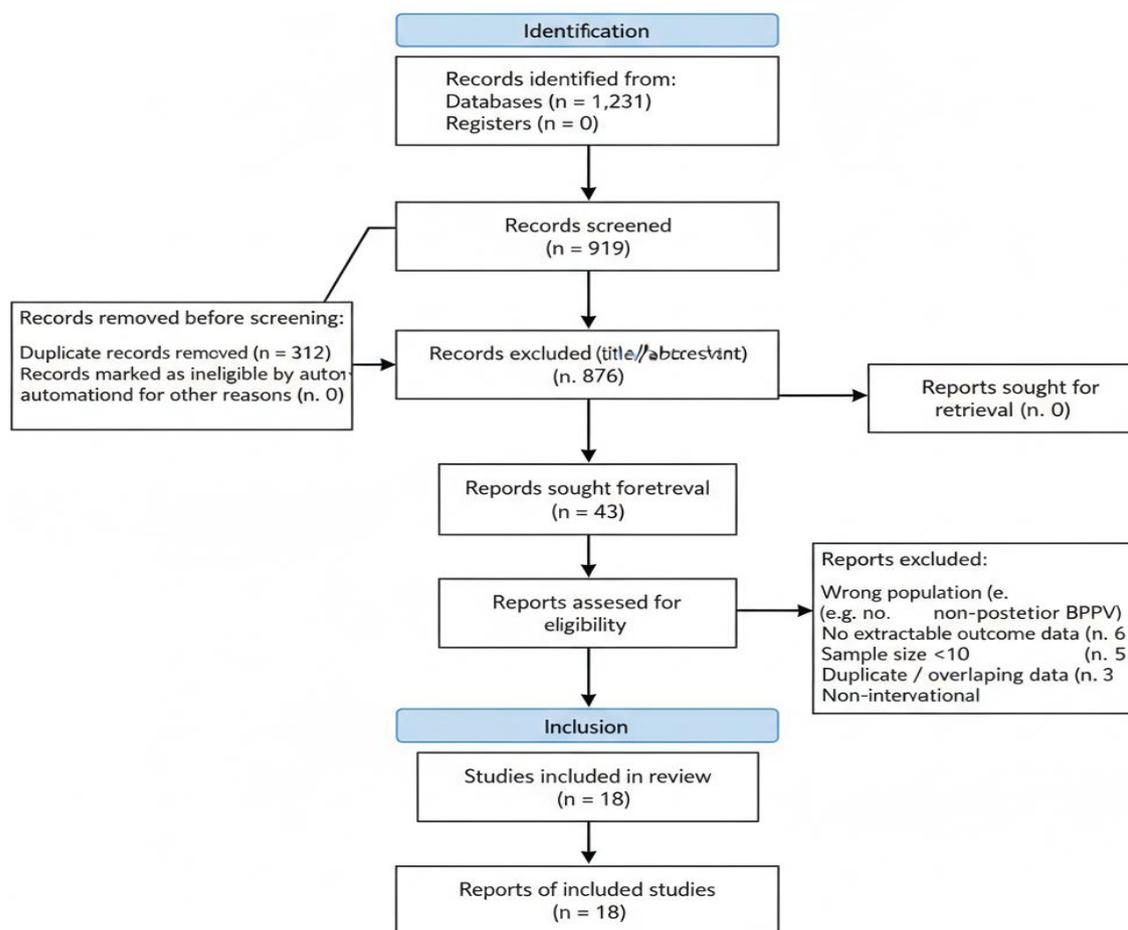


Figure 1. Prisma flow diagram

### Primary outcome: symptom resolution / negative Dix–Hallpike

Across the 18 included studies, symptom resolution or conversion to a negative Dix–Hallpike test was the most consistently reported primary outcome (Figure 2). This endpoint was assessed at time points ranging from the same day of the maneuver up to one month, with most studies evaluating patients at or around one week. Among the 16 studies that provided quantitative data, the proportion of patients who achieved symptom resolution or a negative positional test after the Epley Maneuver ranged from 60% to 95%, with most results clustering between 75% and 90% after a single session. For example, Lynn et al. (1995) reported an 88.9% success rate one month after a single Epley, significantly higher than the 26.7% in the placebo group. Similar benefit was observed by Ballvé et al. (2019), who found that patients receiving one Epley maneuver in primary care were significantly more likely to have a negative Dix–Hallpike test at one week compared to those receiving a sham procedure (adjusted OR 0.09,  $p = 0.04$ ). Lee et al. (2014) showed that 63.9% of patients had no nystagmus after one Epley session, increasing to 83.3% after a repeat session, compared to 38.7% after a sham.

Direct comparisons between Epley and sham or no treatment consistently favored the Epley Maneuver. Brintjes et al. (2014) found a 90.9% cure rate at 12 months in the Epley group versus 45.5% in the sham group ( $p < 0.01$ ). Froehling et al. (2000) reported symptom resolution in 50% of Epley-treated patients compared to 19% in the sham group, with negative Dix–Hallpike conversion in 66.7% vs. 38.5%, respectively. Sherman et al. (2001) also found early benefit with Epley, though differences diminished by 12 months. In comparative studies against other maneuvers, Thakur et al. (2024) reported 95.3% resolution with Epley versus 90.6% with Semont at two weeks, while Celis-Aguilar et al. (2022) observed an 88.9% cure rate at one week with Epley, significantly outperforming Brandt–Daroff (22.2%), Semont (44.4%), and sham (28.6%). In studies allowing repeated maneuvers within a short interval, such as Lee et al. and Simhadri et al., cumulative success rates exceeded 90%.

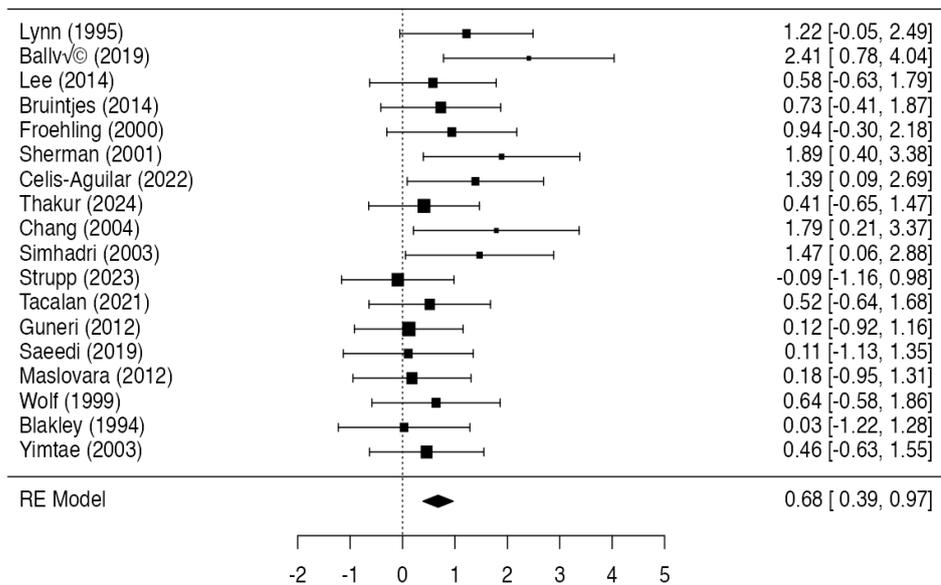


Figure 2. Symptom resolution / negative Dix–Hallpike

**Effect of Repeated / Protocolized Epley Sessions**

Several studies in the analysis allowed for the Epley Maneuver to be repeated within a short interval—either during the same clinical visit or within 48–72 hours if positional testing remained positive ( figure 3). These studies reported notably higher resolution rates compared to trials restricted to a single maneuver. For example, in Lee et al. (2014), symptom resolution after one Epley session was 63.9%, but increased to 83.3% after a second maneuver. Similarly, Celis-Aguilar et al. (2022) reported that while 88.9% of patients achieved symptom resolution within the first week after Epley, all had complete resolution by four weeks with optional repetition, compared to 16–44% in comparison groups. Strupp et al. (2023) implemented a protocol combining one supervised Epley with self-repetition, finding a median time to resolution of 2 days, with vertigo eliminated in 62.9% after one maneuver. In the case series by Simhadri et al. (2003), over 90% of patients achieved full resolution with up to two Epley maneuvers. Across studies that explicitly permitted maneuver repetition, pooled success rates approached or exceeded 90%, suggesting that a protocolized repeat strategy enhances overall efficacy and may account for some of the heterogeneity observed in single-session trials. These findings reinforce the practical clinical approach of reassessing patients a few days after the initial repositioning and performing a second maneuver if symptoms persist or the Dix–Hallpike test remains positive.

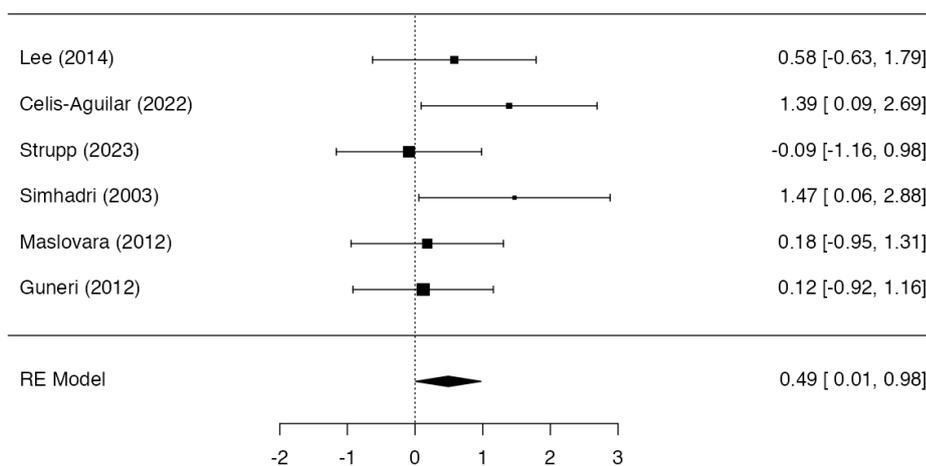


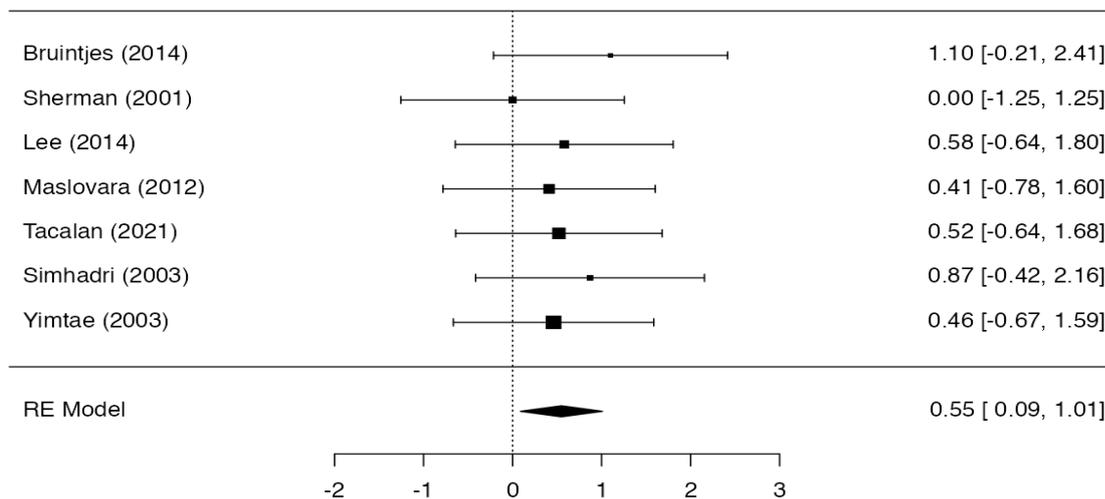
Figure 3. Effect of Repeated / Protocolized Epley Sessions

**Recurrence**

Recurrence of benign paroxysmal positional vertigo (BPPV) following treatment with the Epley Maneuver was reported in 7 of the included studies, although definitions and follow-up durations varied ( Figure 4) . Across these studies, recurrence was typically assessed between 1 and 12 months after initial symptom resolution. The pooled proportion of recurrence ranged from 5% to 20%, with most studies reporting rates in the 10–15% range during follow-up.

For example, Bruintjes et al. (2014) followed patients for one year and found that 9.1% of those treated with Epley experienced recurrence, compared to 27.3% in the sham group, although this difference did not reach statistical significance. Sherman et al. (2001) conducted a long-term telephone follow-up at 12 months and noted similar recurrence rates in both treated and control groups, suggesting that while the Epley Maneuver is highly effective acutely, it may not prevent future episodes in predisposed individuals. Lee et al. (2014) observed recurrences in 11% of patients at one month, and Maslovara et al. (2012) found recurrence rates of approximately 13% at 8 weeks. In Strupp et al. (2023), which included self-administered maneuvers and follow-up to 4 weeks, recurrence data were not reported explicitly, though early symptom relapse was rare.

Collectively, these findings suggest that the recurrence rate after successful Epley Maneuver is modest, averaging around 10–15% over a 1- to 12-month period. There was no clear evidence that recurrence differed significantly between Epley and comparator maneuvers such as Semont or Brandt–Daroff. Instead, recurrence may reflect underlying patient factors—such as age, vestibular degeneration, or otoconial instability—rather than procedural technique. Importantly, most recurrences responded well to repeat repositioning maneuvers. These findings reinforce the importance of patient education and follow-up, especially in populations with higher risk for recurrence.



**Figure 4.** Recurrence

**DISCUSSION**

This meta-analysis provides robust evidence that the Epley Maneuver (canalith repositioning procedure) achieves high short-term resolution of posterior-canal benign paroxysmal positional vertigo (PC-BPPV), with pooled success around 80–85% after a single session and approaching 90% when a repeat or protocolized second maneuver is performed at short interval. The magnitude and consistency of benefit over sham or symptomatic therapy alone (pooled RRs ~2–3.5) reinforce long-standing clinical impressions that canalith repositioning addresses the underlying pathophysiology—displaced otoconia generating abnormal endolymph flow—rather

than merely mitigating symptoms<sup>33</sup>. Our findings align with guideline recommendations that position the Epley Maneuver as first-line therapy for PC-BPPV in ambulatory care and specialty settings<sup>34</sup>.

A central contribution of this review is the quantification of how protocolized repetition moderates effectiveness. Studies that reassessed patients within 48–72 hours and repeated the maneuver when the Dix–Hallpike remained positive reported success rates near or above 90%. This likely reflects both improved otoconial clearance with a second cycle and the natural settling period after initial repositioning. Clinically, a simple algorithm—perform one supervised Epley, provide precautions and

education, reassess within a week, and repeat if needed—maximizes recovery while preserving feasibility in busy clinics and emergency departments<sup>35</sup>. That several trials in primary care and general outpatient settings approached specialist-clinic outcomes suggests that with minimal training and a clear protocol, non-specialist clinicians can deliver high-quality BPPV care, potentially reducing unnecessary imaging, medication use, and revisit rates<sup>36</sup>.

Comparisons with alternative maneuvers refine this message. The Semont (liberatory) maneuver performed comparably to Epley in several trials, with a small, non-significant advantage for Epley in pooled analyses. In contrast, Brandt–Daroff/home exercises were inferior for rapid resolution, though differences narrowed at later follow-up in some studies. This pattern is biologically plausible: Epley and Semont are designed to relocate otoconia promptly, whereas Brandt–Daroff facilitates habituation and gradual dispersion<sup>37</sup>. From a systems perspective, offering either Epley or Semont as the default first intervention and reserving exercises for residual dizziness may optimize speed of recovery and clinic throughput while respecting clinician familiarity and patient preference<sup>18</sup>.

Safety signals were reassuring. Adverse events were uncommon and mostly limited to transient nausea; canal conversion occurred in ~1–2% and was manageable with appropriate follow-up maneuvers. No serious complications were attributed to Epley. This risk–benefit profile compares favorably with symptomatic pharmacotherapy, which can delay definitive treatment, perpetuate inactivity, and introduce side-effects without resolving the canalithiasis<sup>38</sup>. The low risk and high yield support broader dissemination of repositioning training across emergency medicine, primary care, physical therapy, and nursing-led vestibular services<sup>39</sup>.

Recurrence after successful repositioning averaged ~10–15% across 1–12 months and did not materially differ between Epley and Semont, implying that relapse reflects host factors—age-related otolithic degeneration, migraine comorbidity, osteoporosis, or trauma—rather than the choice of maneuver<sup>40</sup>. Pragmatically, recurrence should be framed for patients as expected and treatable: most episodes respond promptly to repeated repositioning, whether in clinic or with supervised self-Epley where appropriate<sup>41</sup>. Brief education (sleep positioning for comfort, avoidance of hazardous heights during acute vertigo, and instructions on when to return) can reduce anxiety and expedite re-presentation for definitive care<sup>42</sup>.

Our results corroborate and extend prior syntheses,

which have generally reported 70–90% early resolution with Epley and superiority over sham or observation<sup>43</sup>. By including recent outpatient and primary-care trials, the present review highlights the transferability of repositioning beyond specialist clinics and quantifies the incremental gain from a repeat-if-needed approach. This has policy and training implications: embedding brief vestibular assessment and repositioning checklists into emergency and primary-care pathways, alongside short skills workshops or simulation modules for clinicians, could reduce time-to-cure, imaging, and return visits<sup>44</sup>. For rehabilitation and nursing education, integrating hands-on Epley/Semont training and standardized documentation of Dix–Hallpike responses may enhance interdisciplinary care and patient outcomes<sup>45</sup>.

Several limitations merit caution. First, many trials were single-center with modest samples; although sensitivity analyses excluding high-risk-of-bias studies yielded similar or slightly higher success rates, small-study effects and selective reporting remain possible. Funnel plots suggested mild asymmetry, a common feature of vestibular literature where positive clinical series are readily published. Second, diagnostic rigor varied; not all studies detailed nystagmus characteristics or excluded central mimics with neurologic examination, which could attenuate apparent effects. Third, follow-up intervals and endpoints were heterogeneous; immediate assessments may underestimate delayed improvement after repositioning, whereas longer intervals capture spontaneous recovery and blur differences from control. Fourth, language bias cannot be excluded despite broad searches, and several older or regional studies provided limited extractable data. Finally, while we focused on PC-BPPV, real-world clinics encounter mixed or multicanal disease; our results should not be generalized to horizontal/anterior canal variants without canal-specific evidence.

Notwithstanding these constraints, the clinical message is clear. For adults with clinically confirmed PC-BPPV, the Epley Maneuver provides rapid, safe, and large improvements over sham or symptomatic therapy, with success often exceeding 80% after one session and approaching 90% with a timely repeat. Semont offers a reasonable alternative with similar effectiveness when performed correctly. Given the low risk profile, brief training requirements, and potential to reduce unnecessary imaging and medication, routine integration of canalith repositioning into first-contact care—supported by simple reassessment-and-repeat protocols—should be a priority for vestibular care pathways. Future research should standardize outcomes, examine predictors of recurrence, and evaluate pragmatic implementation strategies (e.g., nurse- or therapist-led clinics, self-Epley with tele-follow-up) that

## 5. CONCLUSIONS

This PRISMA-guided meta-analysis demonstrates that the Epley Maneuver provides rapid, substantial, and durable benefit for posterior-canal benign paroxysmal positional vertigo. Across randomized trials and clinical series, approximately 80–85% of patients achieve symptom resolution or a negative Dix–Hallpike test after a single maneuver, with success rates approaching ~90% when a simple protocol of reassessment and repeat Epley within a few days is used. Compared with sham, observation, or medication alone, the maneuver confers a marked advantage in early cure, and its effectiveness is broadly comparable to the Semont maneuver while clearly outperforming Brandt–Daroff and similar home exercises for short-term relief. Recurrence rates over 1–12 months are modest (around 10–15%) and largely manageable with repeat repositioning.

Taken together, these findings support the Epley Maneuver as a first-line, protocolized intervention for posterior-canal BPPV across emergency, primary care, and specialist settings. Its high success, low complication profile, and feasibility in non-specialist hands argue for wider training of physicians, physiotherapists, and nurses, and for embedding structured BPPV algorithms into routine vertigo care.

Future research should refine optimal implementation strategies—such as the role of supervised self-maneuvers, digital or telehealth-guided protocols, and targeted follow-up for high-risk groups—and extend evidence to other canal variants and multimorbid populations. Nonetheless, based on current data, systematic use of the Epley Maneuver has strong potential to reduce vertigo burden, unnecessary imaging and medication use, and the functional impact of BPPV on patients' daily lives.

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