Original Article

The Canalith Repositioning Procedure for the Treatment of Benign Paroxysmal Positional Vertigo: A Randomized Controlled Trial

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• ***Objective*: To compare the canalith repositioning procedure (CRP) with a sham maneuver for the treatment of benign paroxysmal positional vertigo.**

• ***Patients and Methods*: We recruited 50 patients with a history of positional vertigo and unilateral positional nystagmus on physical examination (Dix-Hallpike maneuver). Patients were randomized to either the CRP (n=24) or a sham maneuver (n=26). Measured outcomes included resolution of vertigo and positional nystagmus at follow-up examination.**

• ***Results*: The mean duration of follow-up was 10 days for both groups. Resolution of symptoms was reported by 12 (50%) of the 24 patients in the CRP group and by 5 (19%) of the 26 patients in the sham group (*P*=.02). The results of the Dix-Hallpike maneuver were negative for positional nystagmus in 16 (67%) of 24 patients in the CRP group and in 10 (38%) of 26 patients in the sham group (*P*=.046).**

• ***Conclusion*: The CRP is effective treatment of benign paroxysmal positional vertigo, and this procedure can be performed by general internists on outpatients with this disorder.**

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CI = confidence interval; CRP = canalith repositioning procedure

Benign paroxysmal positional vertigo is a common disorder, with an estimated incidence of 160,000 new cases per year in the United States.[1] Among patients seen in a general internal medicine outpatient clinic[2] and in 2 subspecialty dizziness clinics,[3,4] vertigo was the most frequent category of dizziness, and benign paroxysmal positional vertigo was the most common cause of vertigo. This disorder is characterized by a history of positional vertigo and by positional nystagmus (generally torsional with a vertical component) elicited by a head-hanging maneuver,[5-8] usually called the *Dix-Hallpike maneuver*[9] (Figure 1). This condition causes substantial morbidity. In an epidemiological study, at least one third of patients continued to have episodic vertigo more than 1 month after the initial medical visit.[1]

Patients with central nervous system lesions may rarely present with positional vertigo and positional nystagmus with no other neurologic abnormalities.[10] However, in the vast majority of patients, the pathologic site has been localized to the posterior semicircular canals of the vestibular labyrinth of the inner ear.[11,12] Free-moving particles in the endolymph of these canals make them sensitive to position changes and cause symptoms of positional vertigo with head movement.[13,14] Support for the canalithiasis theory comes from the direct intraoperative observation of these free-floating particles.[15,16]

Treatment options have included reassurance, meclizine,[17] Brandt-Daroff exercises,[18] and surgery.[11,19] Many clinicians have advocated a single physical therapeutic approach for benign paroxysmal positional vertigo. A form of therapy described by Semont et al[20] in 1988 (also called the *liberatory maneuver*) involves moving the seated patient quickly from sitting to lying with the affected ear down, then quickly over so the other ear is down, and then back to the sitting position. A form of therapy described by Epley[14] in 1992 (also called the *canalith repositioning procedure* [CRP]) involves a 5-position cycle in which the patient's head is moved about in such a way as to displace theoretically any loose material in the posterior semicircular canal into the utricle of the vestibular labyrinth (Figures 2 and 3).

Results from uncontrolled studies performed at other institutions using one or the other of these 2 physical therapy maneuvers have been encouraging, with response rates of 51% to 84%.[14,20,22-24] These studies were performed in patients referred to subspecialty clinics and may not

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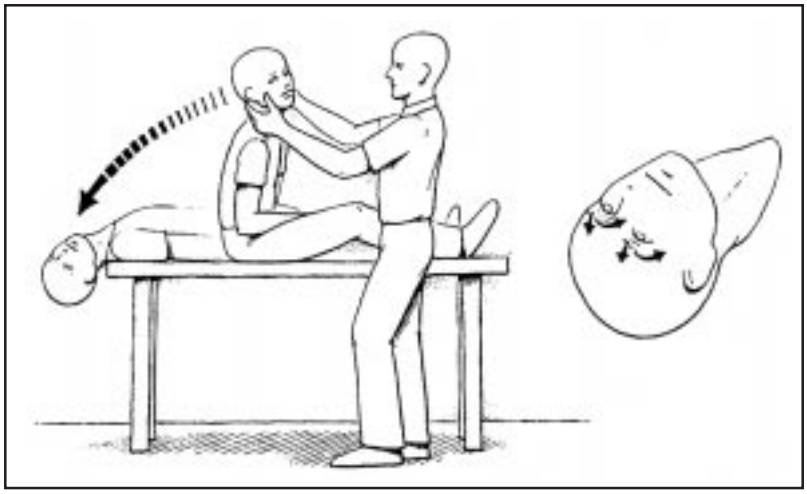

Figure 1. Testing for positional nystagmus affecting the right ear, with an example of the usual type of positional nystagmus seen in right-sided benign paroxysmal positional vertigo (from Mohr[6] with permission).

reflect results seen in a general practice. The Semont maneuver and Epley maneuver are probably equally effective treatment for benign paroxysmal positional vertigo.[24] However, the Epley maneuver is more gentle and easier to perform in a geriatric population.[23] The mean age of patients in a population-based study was 51 years; about one third of the patients were age 60 years or older.[1]

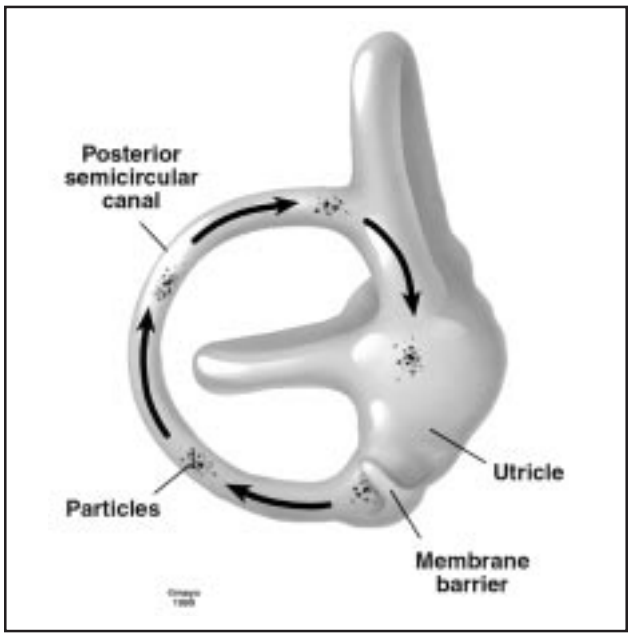

Figure 2. The canalith repositioning procedure for the treatment of benign paroxysmal positional vertigo. A series of maneuvers transfers particles from the posterior semicircular canal into the utricle (from *Mayo Clinic Health Letter*[21]).

Benign paroxysmal positional vertigo is a common condition, and most patients seek initial care from primary care physicians. Accordingly, it would be useful to test whether the Epley maneuver is effective when performed by generalist physicians in an ambulatory setting. Any proposed new treatment for a disorder with a variable natural history should be studied in a randomized controlled clinical trial. This is certainly true for this condition because many patients get better eventually with no specific therapy.[1] For these reasons, a prospective, randomized, double-blind, placebo-controlled trial of a modified form of the Epley maneuver (the CRP) for the treatment of benign paroxysmal positional vertigo and unilateral positional nystagmus was conducted in patients from a general internal medicine outpatient practice.[25] The primary outcomes were self-reported resolution of vertigo and a negative result of the Dix-Hallpike maneuver at follow-up.

PATIENTS AND METHODS

Patients

Patients age 18 years or older with positional vertigo were recruited from the outpatient Urgent Care Center and divisions of community and area general internal medicine at the Mayo Clinic in Rochester, Minn. All the patients resided within 120 miles of Rochester and were referred by their primary care physicians to enroll in the study if they were thought likely to fulfill the study criteria. Most patients were residents of Olmsted County, Minn, of which Rochester is the county seat. Inclusion criteria included positional vertigo and positional nystagmus in either the right or the left Dix-Hallpike head-hanging position. All patients had torsional positional nystagmus with a vertical

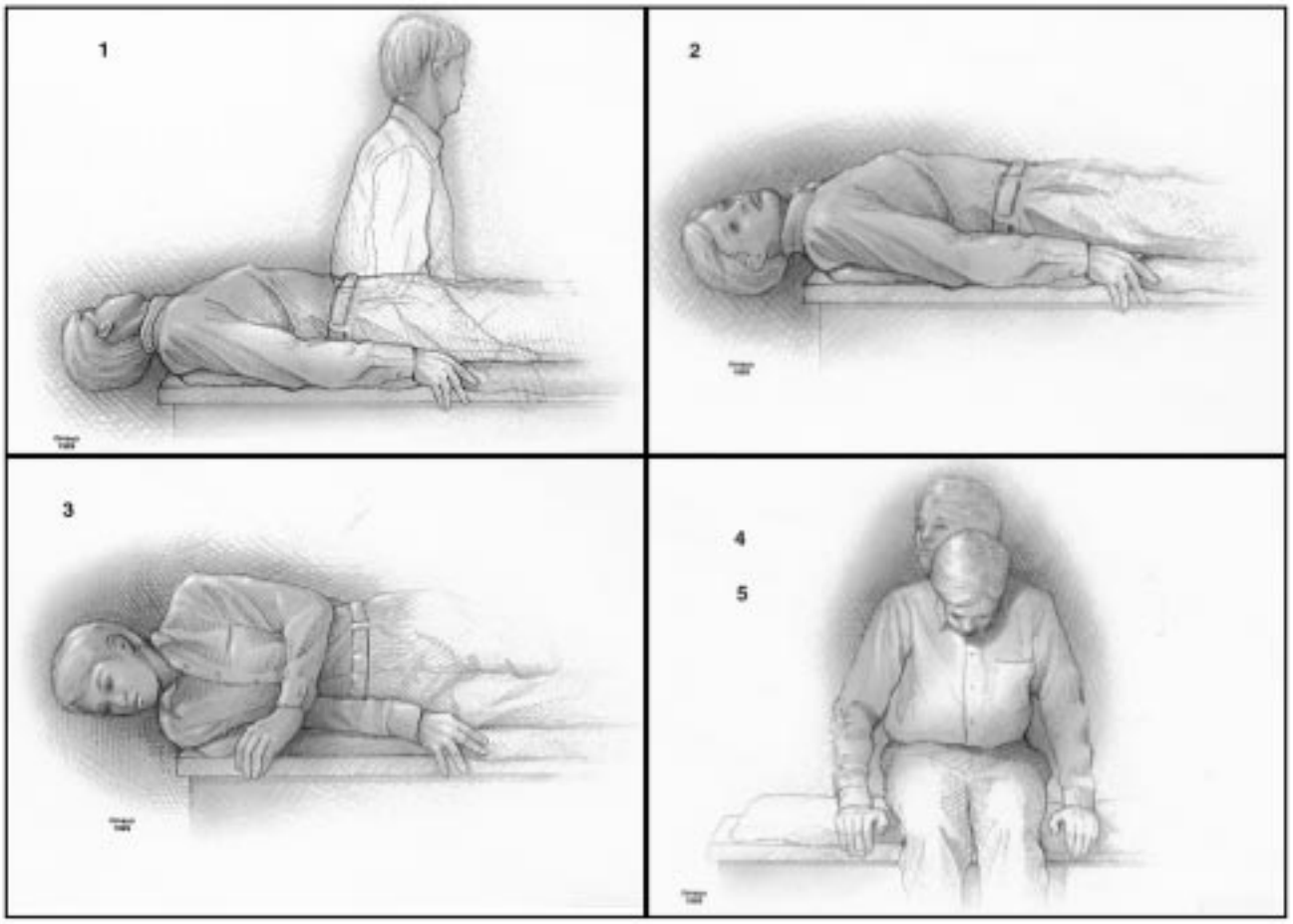

Figure 3. The 5 steps of the canalith repositioning procedure for treatment of left-sided benign paroxysmal positional vertigo. Step 1. Move patient from a sitting to a reclining position. Extend patient's head over the end of the table at 45° angle. Step 2. Turn the patient's head to the opposite side. Step 3. Roll the patient over onto that side. The head is slightly angled while the patient is looking down at the floor. Step 4. Return the patient to a sitting position. Step 5. Tilt the patient's chin down (from *Mayo Clinic Health Letter*[21]).

component, as described by Mohr[6] and Furman and Cass.[8] Exclusion criteria included gaze-evoked nystagmus (±30° horizontally and vertically), positive result of the Dix-Hallpike maneuver in both right and left head-hanging positions, evidence of ongoing central nervous system disease (eg, transient ischemic attack), otitis media, otosclerosis, and inability to tolerate a diagnostic Dix-Hallpike head-hanging maneuver because of restricted head movement or severe positional vertigo with nausea or vomiting. Benign paroxysmal positional vertigo was diagnosed entirely from the history and physical examination of the patients. Frenzel glasses were not used in this study. No vestibular or other laboratory studies were performed. All potential study patients were interviewed and examined by a study nurse and a physician. This study was approved by the Mayo Foundation Institutional Review Board, and all patients gave written informed consent before entering the study.

Randomization

Patients were randomized to undergo the CRP or a sham maneuver. These maneuvers were performed by one of us (D.A.F. or J.M.B.). Evaluation at follow-up was performed by a study nurse masked to the type of maneuver. Randomization was stratified by age and sex.

Therapeutic Maneuver

A 5-position cycle (the CRP) described by Epley[14] was used for treatment (Figure 3). Patients with right-sided positional nystagmus were treated with a right-sided CRP; those with left-sided positional nystagmus were treated with a left-sided CRP. This was a modified Epley maneuver in that we did not use a mastoid vibrator. The time that each patient spent in each position was equal to the latency plus the duration of the positional nystagmus observed during the initial diagnostic Dix-Hallpike maneu-

Table 1. **Patient Characteristics at Initial Examination***

Characteristic	CRP (n=24)	Sham (n=26)	*P* value
Median age (y)	64	64	.71
Males	9 (38)	9 (35)	>.99
Olmsted County resident	13 (54)	13 (50)	.78
Vertigo was main reason for seeing primary physician	8 (33)	11 (42)	.57
Median duration of symptoms, days	43	35	.70
Use of meclizine before study	6 (25)	8 (31)	.76
Ear fullness	22 (92)	22 (85)	.70
Headache	5 (21)	11 (42)	.14
Vomiting	5 (21)	4 (15)	.72
Right-sided positional nystagmus	11 (46)	15 (58)	.57
Median latency of nystagmus (s)	3	3	.87
Median duration of nystagmus (s)	9	9	.32

*Values are number (%) of patients unless specified otherwise. CRP = canalith repositioning procedure.

ver performed by the study nurse. The 5-position cycle was repeated until no positional nystagmus was elicited during any of the position changes or until a total of 5 cycles had been performed. Patients were asked not to describe the maneuver to the study nurse at the subsequent visit.

Sham Maneuver

Patients were asked to lie on the examination table with the symptomatic side down for 5 minutes. They were then asked to sit up. Patients were asked not to describe the maneuver to the study nurse at the subsequent visit.

Patient Instructions

All patients were provided with a cervical collar and were asked to sleep sitting up for the first 2 nights after either the therapeutic or the sham maneuver. They were told to wear the collar only at night and only for the first 2 nights. Furthermore, patients were asked not to sleep on the symptomatic side for an additional 5 days and to avoid excessive turning of the head for 1 week after the initial visit.

Outcome Measurements

All patients were asked to return 1 to 2 weeks after the initial visit and were interviewed by the study nurse. The study nurse also performed the Dix-Hallpike maneuver on each patient. The primary outcomes were self-reported resolution of vertigo and the presence or absence of positional nystagmus. All patients were asked: "Do you feel that it [the dizziness] has completely resolved?"

Statistical Methods

Comparisons between the 2 randomized groups at the initial examination were made by the Wilcoxon rank sum test. The proportion of patients with self-reported resolution of vertigo at follow-up for the 2 groups (CRP and sham) was compared by using the χ^2 test; the proportion with a negative result of the Dix-Hallpike maneuver at follow-up was also compared by using the χ^2 test. The association of clinical characteristics at the time of the initial examination with the primary outcomes was analyzed with logistic regression. Statistical analysis was performed with use of SAS software.

RESULTS

Patients

Patients with positional vertigo (N=112) were referred to the study from October 1994 to June 1997. Patients were excluded (n=62) from entry for the following reasons: negative result of the Dix-Hallpike maneuver (50), bilateral positive result of the Dix-Hallpike maneuver (6), inability to tolerate a Dix-Hallpike maneuver (3), pathologic gaze-evoked nystagmus (1), otitis media (1), and otosclerosis (1). Fifty patients fulfilled entry criteria and were enrolled in the study.

Patients were randomized to the CRP (n=24) or to the sham maneuver (n=26). There were no appreciable differences between the 2 groups in any clinical variables at randomization (Table 1). All patients returned for follow-up. The mean (± SD) duration of follow-up was 9.5±2.5 days for the CRP group and 10.2±5.6 days for the sham group.

Interventions and Complications

The 24 patients randomized to the CRP were treated with a median of 3 cycles of a modified form of the Epley maneuver. None of the patients were premedicated before the CRP. Three (13%) of the 24 patients had persistent positional nystagmus throughout 5 cycles of treatment, and their condition was considered an immediate treatment failure; all 3 returned for follow-up. There were no problems associated with the sham maneuver. Reported patient compliance with instructions was good. At follow-up, 49 (98%) of 50 patients reported wearing the cervical collar for at least 1 night.

Interventions were generally well tolerated, but 2 complications occurred. One patient wore his cervical collar all the time for more than 1 week, and a pressure sore developed on his chin. Another patient had emesis during the CRP.

Outcomes

Table 2 summarizes the results of self-reported resolution of symptoms and objective evidence of resolution with

Table 2. **Outcome of the 50 Patients at Follow-Up**

Criterion	CRP (n=24)		Sham (n=26)		Difference		*P*
	No. (%)	95% CI	No. (%)	95% CI	(%)	95% CI	value
Resolution of vertigo	12 (50)	30-70	5 (19)	4-34	31	4-57	.02
Negative result of Dix-Hallpike maneuver	16 (67)	48-86	10 (38)	20-57	28	5-56	.046

*CI = confidence interval; CRP = canalith repositioning procedure.

a negative result of the Dix-Hallpike maneuver at follow-up. Twelve patients (50%; 95% confidence interval [CI], 30%-70%) in the CRP group reported that their vertigo had resolved compared with 5 patients (19%; 95% CI, 4%-34%) in the sham group (P=.02, χ^2 test). The absolute improvement in the resolution of vertigo in the CRP group compared with the sham group was 31% (95% CI, 4%-57%). In addition, 16 patients (67%; 95% CI, 48%-86%) in the CRP group had negative results of the Dix-Hallpike maneuver at follow-up compared with 10 patients (38%; 95% CI, 20%-57%) in the sham group (P=.046, χ^2 test). The absolute improvement in objective findings in the CRP group compared with the sham group based on a negative result of the Dix-Hallpike maneuver was 28% (95% CI, 5%-56%). The type of maneuver performed (CRP vs sham) was the only variable associated with resolution of vertigo; none of the patient characteristics were associated with resolution of vertigo.

DISCUSSION

In this prospective, randomized, controlled trial of the CRP for the treatment of benign paroxysmal positional vertigo, more patients randomized to the CRP maneuver reported resolution of vertigo than did patients randomized to a sham maneuver. This evidence of benefit from the CRP is supported by the observation that objective nystagmus with the Dix-Hallpike maneuver was less frequent after the procedure. These results suggest that the CRP is effective treatment of this disorder.

There have been only 2 other similar published randomized controlled trials of the CRP for the treatment of benign paroxysmal positional vertigo, and these were conducted in a subspecialty ear, nose, and throat setting. In the study by Lynn et al[26] of the CRP, 11 (61%) of 18 treated patients had self-reported resolution of vertigo at 1-month follow-up compared with 3 (20%) of 15 control subjects undergoing a placebo maneuver (P=.03). In that study, 16 (89%) of 18 treated patients had a negative result of the Dix-Hallpike maneuver at follow-up compared with 4 (27%) of 15 control subjects undergoing a placebo maneuver (P<.001). Blakley,[27] however, found no benefit with the CRP. In that study, 7 (44%) of 16 treated patients had self-reported resolution of vertigo at 1-month follow-up compared with 11 (50%) of 22 control subjects given no treatment (P = not significant). A Dix-Hallpike maneuver was not done at follow-up in Blakley's study. Our study of patients in a general internal medicine outpatient setting is in general agreement with Lynn's study, which was also done at our institution, but not with Blakley's study. The better results from the procedure in Lynn's study compared with our study may have been due to the special characteristics of the 2 populations. Median duration of symptoms in Lynn's study was 11 months compared with 39 days in our study.

Two other randomized controlled trials have shown benefit for treatment of benign paroxysmal positional vertigo with the CRP. In a recent prospective study by Wolf et al,[28] 39 of 41 patients treated with a modified form of the Epley maneuver had resolution of vertigo and positional nystagmus vs 5 of 10 untreated patients (P=.005). This study differed from ours in that treated patients received the CRP weekly until symptoms subsided. In a prospective controlled trial by Li,[29] mastoid oscillation seemed to be crucial to the successful performance of the CRP. We did not use mastoid oscillation in our study.

Our study has several limitations. First, the results apply only to patients with benign paroxysmal positional vertigo. Empirical use of the CRP for patients with positional vertigo who can lateralize their symptoms but who lack objective positional nystagmus may be reasonable but cannot be supported by this study. Second, our inclusion and exclusion criteria were based entirely on the history and physical examination (but this could also be considered a strength of the study). We performed no vestibular or audiological testing on our patients, and we may have inadvertently included some patients with acute vestibular neuronitis (for whom the CRP would not be effective). Nevertheless, we suspect that this number was small because patients with pathologic gaze-evoked nystagmus were excluded. Finally, we observed that the CRP was difficult to perform in some obese or elderly patients. Appropriate performance of the maneuver requires a person well trained in its execution, frequent practice or performance of the maneuver, and an understanding of the anatomy of the vestibular labyrinth and the pathophysiology of benign paroxysmal positional vertigo.

In 1 study, 6% of patients with benign paroxysmal positional vertigo had a horizontal canal variant. These patients were characterized by horizontal positional nystagmus and may be best treated with a 360° barbecue rotation.[30]

Posttreatment instructions, including use of a cervical collar, were included in our study because of their use by Epley and others and the belief that the collar helps prevent movement of the particles back into the posterior semicircular canal. Nevertheless, following these instructions is inconvenient, and a study by Massoud and Ireland[31] suggests that this is unnecessary.

The utility of performing the CRP more than once during a single treatment session is unclear. Furman and Cass[8] recommended repeating the maneuver until the patient is asymptomatic.

In conclusion, this study provides evidence that the CRP is effective treatment of benign paroxysmal positional vertigo. In a general internal medicine outpatient practice, it may be reasonable to treat patients with the clinical diagnosis of this disorder with the CRP without further testing. Referral or further evaluation may be appropriate for patients who do not respond to the CRP.

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