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A comparative study on effectiveness of the rolling-over maneuver in rehabilitation of patients with posterior semicircular canal benign paroxysmal positional vertigo

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Hypothesis
Benign paroxysmal positional vertigo (BPPV) is a common vestibular disorder. The canalith repositioning procedure (CRP) is known to be an effective therapy for the treatment of BPPV. However, because of its various movements of the head and body, it is impossible to perform in BPPV patients with orthopedic impairments or in the elderly.
The rolling-over maneuver (ROM) involves easy movements, with only a small load. This therapy is suitable for most BPPV patients, especially for those without an indication for CRP. Hence, we propose that ROM is as effective as CRP for the treatment of BPPV.

Purpose
In this study, we compared among the ROM, Epley, and Brandt–Daroff maneuvers in the management of patients with posterior semicircular canal-type BPPV.

Patients and methods
The study included 60 patients with BPPV who were randomized and divided into the following three groups: (i) those treated by Epley maneuver as CRP; (ii) those treated by ROM; and (iii) those treated by the Brandt–Daroff maneuver.

Results
The findings of this study demonstrated that the success rate was the best in patients who were treated with Epley maneuver (90%), then in patients treated with ROM (85%) followed by those treated with the Brandt–Daroff maneuver (80%). The recurrence rate after management was high in patients treated with the Brandt–Daroff maneuver (31.25%), with no statistically significant difference.

Conclusion
We recommend either Epley maneuver in the office or ROM at home, according to the general condition of the patient.

Keywords:
benign paroxysmal positional vertigo, Brandt–Daroff maneuver, canalith repositioning procedure, Epley maneuver, rolling-over maneuver

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Introduction and rationale

Benign paroxysmal positional vertigo (BPPV) is considered to be the most common peripheral vestibular disorder, particularly in the elderly. By the age of 70 years, about 30% of all elderly individuals have experienced BPPV at least once [1]. This condition is characterized by brief attacks of rotatory vertigo and concomitant positioning rotatory-linear nystagmus, which are elicited by rapid changes in the head position relative to gravity.

It is known that BPPV develops in stages: first, the otoconia detach from the utricular matrix, and then they enter into a semicircular canal when the head assumes a critical position. Furthermore, it has been shown by means of physiomathematical models that the prerequisites for BPPV are: (i) there should be ~62 otoconia within the semicircular canal and (ii) these particles have to agglomerate to exert a hydrodynamic effect when moving in the canal [2,3].

Schuknecht and Ruby [4] hypothesized that heavy debris settles on the cupula (cupulolithiasis) of the canal, transforming it from a transducer of angular acceleration to a transducer of linear acceleration. It is now generally accepted, however, that the debris floats freely within the endolymph of the canal (canalolithiasis). The debris – possibly particles detached from the otoliths – congeals to form a free-floating clot (plug). As the clot is heavier than the endolymph, it will always gravitate to the most dependent part of the canal during changes in the head position, which alters the angle of the cupular plane relative to gravity. Analogous to a plunger, the clot induces bidirectional (push or pull) forces on the cupula, thereby triggering the BPPV attack. Most patients with BPPV (90.2%) have involvement of the posterior semicircular canal, and in most patients physical therapy is effective [3–5].

In 1980, Brandt and Daroff [6] proposed the first effective physical therapy (positioning exercises) for

BPPV based on the assumption that cupulolithiasis was the underlying mechanism; the exercises were a sequence of rapid lateral head/trunk tilts, repeated serially to promote loosening and, ultimately, dispersion of the debris toward the utricular cavity. In 1988, Semont *et al.* [7] introduced a single liberatory maneuver, and Epley promoted a variation in 1992, which Herdman *et al.* [8] later modified. If performed properly, all three forms of therapy (the Brandt–Daroff exercises and Semont and Epley maneuvers) are effective in BPPV patients [6–9].

However, all previous maneuvers require various movements of the head and body; hence, it is impossible to perform these in BPPV patients with movement disability, neck or spine disorders or in the elderly. Sugita-Kitajima *et al.* [10] had proposed a therapy called the rolling-over maneuver (ROM) that requires only simple head movements; they reported high percentages of improvements in those patients within 2 weeks.

In this study, we investigate the efficacy of ROM in patients with posterior semicircular canal-type BPPV. In this study, we compared the efficacy of ROM with that of the canalith repositioning procedure (CRP) and Brandt–Daroff maneuvers in patients with posterior semicircular canal-type BPPV.

Patients and methods

The study was conducted in the Vestibular Unit, ENT Department, Ain Shams University, and included 60 patients with the diagnosis of posterior semicircular canal BPPV. All patients were subjected to complete neuro-otologic evaluation to identify other labyrinthine or neurological disorders. This evaluation included complete history taking, Dizziness Handicap Inventory (DHI), physical examination, vestibular office tests including spontaneous head-shake and positional nystagmus, the Dix–Hallpike test (with Frenzel's glasses), ocular range of motion, ocular motor tests, head thrust test, and Modified Clinical Test of Sensory Interaction and Balance.

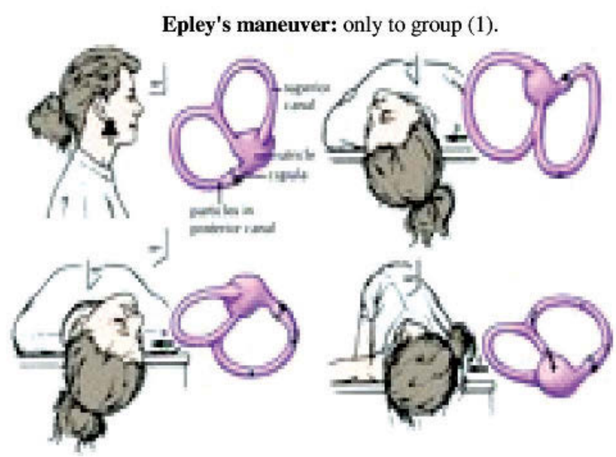
Diagnosis of posterior canal BPPV was based on the Dix–Hallpike test for evaluation of nystagmus with the following selection criteria:

(1) Absence of an identifiable central nervous system disorder that would explain positional vertigo at neurological examination and in neurophysiologic studies.
(2) No spontaneous nystagmus.
(3) Nystagmus occurs within 10 s after positioning, shorter in cupulolithiasis.
(4) Torsional nystagmus involves alternating quick eye rotations toward the affected ear and slow eye rotations in the opposite direction.
(5) Reverses its direction after the patient returns to the seated position.
(6) Subsides within a minute or less in canalithiasis but can persist much longer in cupulolithiasis.
(7) Vertiginous symptoms are invariably associated.
(8) Fatigable if the maneuver is repeated.

Demographic data and duration of symptoms until treatment were recorded for each patient. We only included patients with unilateral posterior semicircular canal BPPV; we excluded patients with other forms of BPPV and those who did not return for the follow-up visits. The patients were randomized in this prospective study and divided into three groups:

(1) Group 1: patients were treated by the Epley maneuver as CRP. This maneuver was performed at the first visit to the hospital (Fig. 1).
(2) Group 2: patients were treated by ROM [8,10]. ROM was performed at home, three times per day for 2 weeks (Fig. 2).

Figure 1



Epley maneuver: applied only to group 1. Particle repositioning maneuver (right ear). Schema of patient and concurrent movement of posterior/superior semicircular canals and utricle. The patient is seated on a table as viewed from the right side (A). Before moving the patient into position B, turn the head 45° to the side being treated. Patient in normal Dix–Hallpike head-hanging position (B). Particles gravitate in an ampullofugal direction and induce utriculofugal cupular displacement and subsequent counter-clockwise rotatory nystagmus. This position is maintained for 1–2 min. The patient's head is then rotated toward the opposite side with the neck in full extension through position C and into position D in a steady motion by rolling the patient onto the opposite lateral side. The change from position B to D should take no longer than 3–5 s. Particles continue gravitating in an ampullofugal direction through the common crus into the utricle. The patient's eyes are immediately observed for nystagmus. Position D is maintained for another 1–2 min, and then the patient sits back up to position A. Otolaryngology Head Neck Surg 1997; 116: 238–243). Photo by: Christine Kenney [13].

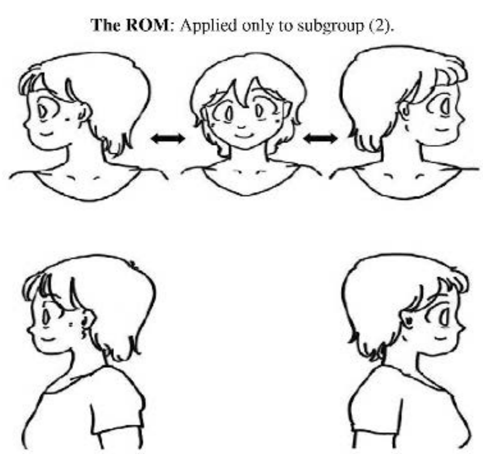
(3) Group 3: patients were treated by the Brandt–Daroff maneuver. The Brandt–Daroff maneuver was performed at home, three times per day for 2 weeks (Fig. 3).

All patients were followed up every week after the initial visit. At every visit, the patients underwent the Dix–Hallpike positioning test to indicate the onset of positioning nystagmus remission; in addition, patients were asked to indicate the time at which the symptom of positional vertigo disappeared.

Statistical analysis

The data were analyzed with SPSS for Windows (version 18; SPSS Inc., Chicago, Illinois, USA). Pre-exercise and postexercise DHI results were compared using the paired *T*-test. Comparison among the study groups and comparison between the study groups and the control group were made using the χ^2 and analysis of variance tests. A *P* value of less than 0.05 was considered statistically significant for analyses.

Figure 2



The rolling-over maneuver (ROM): applied only to group 2. The procedure of performing ROM. As shown in the figure, this therapy involved moving the patient from a supine and nose-up position to a right-ear-down head position (A), and maintaining this position for 10 s before subsequently returning the head to a nose-up position, which was maintained for a further 10 s (B). The patient was then moved to a left-ear-down head position, which was maintained for 10 s (C), before returning to the original nose-up position. The right-ear-down and left-ear-down positioning were performed with only head movement by neck torsion or whole body movement without neck torsion, depending on the capabilities of the patients (A′, C′). Patients repeated these maneuvers 10 times in one set, and they performed two sets a day (before getting up in the morning and before sleeping at night). Adapted from Sugita-Kitajima *et al.* [11]. Adaptations are themselves works protected by copyright. So in order to publish this adaptation, authorization must be obtained both from the owner of the copyright in the original work and from the owner of copyright in the translation or adaptation.

Results and Discussion

The study was conducted in the Vestibular Unit, ENT Department, Ain Shams University, and it comprised 60 patients (26 men and 34 women). The mean age for the whole studied population was 50.8±10.2 years, with an age range of 22–81 years (Table 1). Increased incidence of occurrence of BPPV in elderly can be explained by degeneration of the vestibular system of the inner ear. These results agree with most BPPV studies [12–14] (Table 2).

Vibert *et al.* [15] concluded that BPPV was associated with depression, diabetes, hypertension (HTN), and coronary heart disease. In a stepwise backward logistic regression model including all these variables, only age, hypertension, increased blood lipids, stroke, and migraine had an independent effect on BPPV. Their results agree with our data (Table 3) stating that nearly 25% of patients had HTN and 17% of patients had diabetes mellitus, which could be associating diseases because of the effect of old age and degenerative and ischemic changes of otoconia [15].

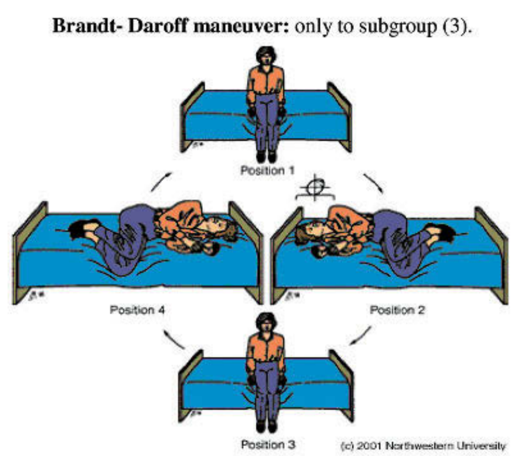
Table 1 Age of patients in the study

	N	Minimum	Maximum	Mean	SD
Age	60	22	81	50.89	10.603

Table 2 Duration of symptoms in weeks of all patients

	X	SD	Range
Duration of symptoms (weeks)	5.32	7.23	1–48

Figure 3



These exercises are performed in three sets per day for 2 weeks. In each set, one performs the maneuver as shown five times. Start sitting upright (position 1). Then move into the side-lying position (position 2), with the head angled upward about halfway. An easy way to remember this is to imagine someone standing about 6 ft in front of you, and just keep looking at their head at all times. Stay in the side-lying position for 30 s or until the dizziness subsides if this is longer, then go back to the sitting position (position 3). Stay there for 30 s, and then go to the opposite side (position 4) and follow the same routine. Otolaryngology Head Neck Surg 1997; 116: 238–43). Photo by: Christine Kenney [13].

Nystagmus latency ranged from no latency (cupulolithiasis) up to 8 s (canalolithiasis) and nystagmus duration ranged from 22 s (canalolithiasis) to 128 s (cupulolithiasis). The canalolithiasis (66.6% of patients) was more common than cupulolithiasis (Tables 4 and 5).

Table 6 shows the DHI scores of patients and reveals that DHI scores significantly decreased after the three rehabilitative maneuvers, reflecting reduction in the perceived dizziness disability. In addition, there was significant difference in the improvement of disability among the three rehabilitative maneuvers, being significantly less in the Brandt–Daroff maneuver (Table 7). This may be explained by the compliance of the Brandt–Daroff maneuver that is relatively less than ROM at home; Epley maneuver is performed in office and did not need the compliance of patients.

Table 8 reveals that the success rate was the best in patients who were treated with the Epley maneuver (90%) followed by patients treated with the ROM maneuver (85%). The worst rate was in the group of patients treated with the Brandt–Daroff maneuver (80%). Moreover, there was no statistically significant difference between the three groups regarding the cure rate (Table 9).

Our results are in agreement with some previous reports that had investigated the role of vestibular habituation training exercises for BPPV patients as a substitution therapy of classic CRP, especially in patients with orthopedic problems, motion disability, and elderly patients [5,10,14,16]. Norré [15] assumed that habituation exercises stimulate the central adapting mechanism. Sugita-Kitajima *et al.* [10] hypothesized that ROM mechanically promotes loosening of the otolithic debris from the cupula and dispersion of the debris into the canal. The fatigability of vertigo in patients with BPPV during individual sessions was too rapid for a habituative central mechanism that required hundreds of repetitions and longer term. The same mechanism was proposed by Brandt *et al.* [5] who reported that positional vertigo resolved within 14 days and who considered the mechanism to be a mechanical loosening and dispersion of otolithic debris from the cupula.

In contrast to our results, some authors believed that supervised exercises such as the CRP maneuver are superior to home self-guided exercises such as ROM and Brandt–Daroff exercises because supervision is helpful in providing both motivation and instruction for correct execution of the exercises to maximize results. They reported that supervised and customized exercises may have more relevance in the population of elderly patients with BPPV because this group has been found to have relatively high rates of functional disability and depression. However, the superiority of supervised exercises over home self-guided exercises has not been validated by well-designed, controlled studies.

Table 3 Associated risk factors in the study patients

	HTN (%)	Trauma (%)	Audiological complaint (%)	DM (%)
Negative	75	90	80	80
Positive	25	10	20	20

Table 4 Nystagmus latency and duration in seconds of all patients

	X	SD	Range
Latency (s)	3.55	2.40	0–8
Nystagmus duration (s)	45.71	20.69	22–128

Table 5 Distribution of all patients according to the type of pathogenesis

	Frequency (%)
Canalithiasis	40 (66.7)
Cupulolithiasis	20 (33.3)
Total	60 (100.0)

Table 6 Dizziness Handicap Inventory scores in the study groups and paired *T*-test before and after therapy

	Group		
DHI	1	2	3
Pre	45 ± 20.27 (8–80)	45 ± 16.38 (24–76)	45 ± 23.51 (10–78)
Post	18.8 ± 17.34 (0–70)	20.5 ± 19.97 (0–66)	25.2 ± 24.09 (0–68)
Paired *T*-test			
t	7.32	7.38	4.79
P	0.00	0.00	0.00

DHI, Dizziness handicap inventory.

Table 7 Repeated multivariate analysis of variance test to study the difference in subjective improvement among the three subgroups

Repeated MANOVA tests	*F*	Significance
DHI (pre vs. post)	185.074	0.000
DHI (type of exercise)	4.956	0.003

DHI, Dizziness handicap inventory; MANOVA, multivariate analysis of variance.

Table 8 Failure rate in canalithiasis versus cupulolithiasis

	Group			
	1	2	3	Total
Cured				
Type				
Canalithiasis	16	8	12	36
Cupulolithiasis	2	9	4	15
Total	18	17	16	51
Not cured				
Type				
Canalithiasis	1	3	0	4
Cupulolithiasis	1	0	4	5
Total	2	3	4	9

Sato *et al.* [17,18] examined BPPV patients with orthopedic disorders and assessed whether the ROM and Brandt–Daroff maneuver can be used as physical therapy for these patients. They found that the Brandt–Daroff maneuver could not be performed in those patients because of their cervical or thoracic spine problems, although their symptoms and signs improved within 14 days of ROM treatment. Even patients without movement impairment are sometimes anxious when performing the Brandt–Daroff maneuver at home because of the large movement of the upper body, and hence those patients tend to stop performing the exercise at home. However, ROM involves only easy movements, namely rolling over in bed; therefore, compliance is relatively good and patients can continue this exercise everyday at home [10].

BPPV is recognized as a disorder with high recurrence rate; hence, we followed up the patients for the first year after maneuver (Table 10). The recurrence rate was higher in the Brandt–Daroff group (31.25%) than in the Epley maneuver group (16.7%) and the ROM maneuver group (17.7%), without statistically significant difference between the three groups (Table 11).

Some of the previous reports are in agreement with our results [19,20]. They found that the Epley maneuver is effective for BPPV, but does not result in long-term resolution of symptoms. Sugita-Kitajima *et al.* [10] hypothesized that the rate of recurrence in habituation exercises is affected by the frequency of the therapy. That is, the therapist should perform CRP at the hospital, although patients themselves could perform habituation exercises (ROM and Brandt–Daroff exercises) at home everyday [10]. However, Sato and Koizuka [18] followed up 12 patients with BPPV after ROM and reported a recurrence rate of 50%, which is higher than our recurrence rate.

Table 9 Comparison between the groups regarding the cure rate using the χ^2-test

	Cure rate in the three study groups
χ^2	0.771
d.f.	2
Significance	0.680

Table 10 Frequency and rate of recurrence during the first year after management

	Group [*N* (%)]		
	1	2	3
Positive	15 (83.3)	14 (82.3)	11 (68.75)
Negative	3 (16.7)	3 (17.7)	5 (31.25)
Total	18 (100)	17 (100)	16 (100)

Table 11 Comparison between the three groups according to the rate of recurrence

	Value	*d.f.*	Significance (two-sided)
Pearson's χ^2	1.039	3	0.792

Conclusion

The findings of this study demonstrated that the success rate was the best in patients who were treated with the Epley maneuver (90%), then in patients treated with ROM (85%) followed by those treated with the Brandt–Daroff maneuver (80%). The failure rate is less in canalithiasis than in cupulolithiasis, with significantly higher subjective improvement after both Epley and ROM maneuvers.

The recurrence rate after management is more in patients treated with the Brandt–Daroff maneuver (31.25%), with no statistically significant difference. Hence, we recommend either Epley maneuver in the office or ROM at home, according to the general condition of the patient.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

References

1 Nedzelski JM, Barber HO, McIlmoyl L. Diagnosis in a dizziness unit. J Otolaryngol 1986; 15:101–104.

2 Epley J. Positional vertigo related to semicircular canalithiasis. Otolaryngol Head Neck Surg 1995; 112:154–161.

3 Welling D, Parnes L, O'Brien B. Particulate matter in the posterior semicircular canal. Laryngoscope 1997; 107:90–94.

4 Schuknecht H, Ruby R. Cupulolithiasis. Adv Otorhinolaryngol 1973; 20:434–443.

5 Brandt T, Steddin S, Daroff R. Therapy for benign paroxysmal positioning vertigo, revisited. Neurology 1994; 44:796–800.

6 Brandt T, Daroff R. Physical therapy for benign paroxysmal positional vertigo. Arch Otolaryngol 1980;106:484–485.

7 Semont A, Freyss G, Vitte E. Curing the BPPV with a liberatory maneuver. Adv Otorhinolaryngol 1988; 42:290–293.

8 Herdman SJ, Tusa RJ, Zoe DS, Proctor LR, Mattax DE. Single treatment approaches to benign paroxysmal positional vertigo. Arch Otolaryngol Head Neck Surg 1993; 119:450–454.

9 Epley JM. The canalith repositioning procedure for treatment of benign paroxysmal positional vertigo: Otorhinolaryngol Head Neck Surg 1992; 107:399–404.

10 Sugita-Kitajima A, Sato S, Mikami K, Mukaide M, Koizuka I. Does vertigo disappear only by rolling over? Rehabilitation for benign paroxysmal positional vertigo. Acta Otolaryngol 2010; 130:84–88.

11 Sugita-Kitajima A, Sato S, Mikami K, Mukaide M, Koizuka I. Rehabilitation for BPPV, comparisons between ROM and CRP. Equilibrium Res 2011; 2:85–87.

12 Froehling DA, Silverstein MD, Mohr DN, Beatty CW, Offord KP, Ballard DJ. Benign positional vertigo: incidence and prognosis in a population-based study in Olmsted County, Minnesota. Mayo Clin Proc 1991; 66:596–601.

13 Parnes LS, Robichaud J. Further observations during the particle repositioning maneuver for Benign Paroxysmal Positional Vertigo. Otolaryngology Head Neck Surg 1997; 116:238–43.

14 Norré ME. Rationale of rehabilitation treatment for vertigo. Am J Otolaryngol 1987; 8:31–35.

15 Vibert D, Kompis M, Hausler R. Benign paroxysmal positional vertigo in older women may be related to osteoporosis and osteopenia. Ann Otol Rhinol Laryngol 2003; 112:885–889.

16 Steenerson RL, Cronin GW. Comparison of the canalith repositioning procedure and vestibular habituation training in forty patients with benign paroxysmal positional vertigo. Otolaryngol Head Neck Surg 1996; 114:61–64.

17 Sato S, Ohashi T, Koizuka I. Physical therapy for benign paroxysmal positional vertigo patients with movement disability. Auris Nasus Larynx 2003; 30:S53–S56.

18 Sato S, Koizuka I. Non-specific physical therapy for benign paroxysmal positional vertigo. Equilibrium Res 2006; 65:161–167.

19 Szturm T, Ireland DJ, Lessing-Turner M. Comparison of different exercise programs in the rehabilitation of patients with chronic peripheral vestibular dysfunction. J Vestib Res 1994; 4:461–479.

20 Sekine K, Imai T, Sato Go, Ito M, Takeda N. Natural history of benign paroxysmal positional vertigo and efficacy of Epley and Lempert maneuvers. Otolaryngol Head Neck Surg 2006; 135:529–533.