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Original Paper

A Comparison of Two Home Exercises for Benign Positional Vertigo: Half Somersault versus Epley Maneuver

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Key Words
Benign paroxysmal positional vertigo · Half somersault exercise · Epley maneuver

Abstract
Benign paroxysmal positional vertigo (BPPV) frequently recurs after treatment, so a home exercise would be desirable. We designed a self-administered exercise, the half somersault, for home use. In this randomized single-blind study, we compare the efficacy of our exercise to self-administered Epley maneuvers in patients with BPPV. Subjects performed exercises twice while observed, were re-tested with the Dix Hallpike, and then reported on exercise use for 6 months. Outcome measures were the reduction of nystagmus intensity, tolerability of induced dizziness, and long-term efficacy. Both exercises resulted in a significant reduction in nystagmus after two self-applications. The Epley maneuver was significantly more efficacious in reducing nystagmus initially, but caused significantly more dizziness during application than the half somersault. During the 6-month follow-up, the Epley group had significantly more treatment failures than the half somersault group. We believe that both exercises can be self-applied to control symptoms, but the half somersault is tolerated better and has fewer side effects as a home exercise.

Introduction

Benign paroxysmal positional vertigo (BPPV) is a common vertigo disorder in which otoconia normally adherent to the utricle become displaced into the semicircular canals [Lanska and Remler, 1997; Parnes and McClure, 1992; Welling et al., 1997]. These can be

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cleared from the semicircular canals by canalith repositioning (CRP), resolving the dizziness [White et al., 2005]. This is usually performed by a clinician or therapist. In the 1980's, two treatments for the posterior canal variant, the Epley and Semont maneuvers, were independently devised, and both have been found to be similar in efficacy, which exceeds 90% [Epley, 1992; Semont et al., 1988; White et al., 2005]. Other maneuvers have been described for the horizontal and anterior canal variants [Appiani et al., 2001; Casani et al., 2011], and a number of minor variations of all these maneuvers have been reported. Ideally a maneuver is applied several times in the course of one treatment session, until no further symptoms can be elicited [Epley, 1992]. Because particles can again become displaced into the semicircular canals over time, it is possible to have recurrences, which approach 50% over 1–3 years [Beynon et al., 2000; Nunez et al., 2000]. Usually patients with recurrences return to clinic for further maneuvers, but home exercises should be more cost-effective.

These maneuvers have been posted on the internet, depicted in written sources, and are given out by physicians directly to patients who use them to perform exercises at home [Furman and Hain, 2004; Radtke et al., 1999; Radtke et al., 2004]. In order to be used effectively by patients, the ideal exercise should be reasonably simple to learn and apply, and have minimal side effects. An exercise that successfully relocates the causative particles without causing dizziness would be preferred from a patient standpoint. The Epley maneuver is popular in ENT practices in the U.S. and is often taught for home use [Radtke et al., 1999]. However, it has limitations, listed below, that may reduce its utility as a home exercise. The Semont maneuver has similar limitations.

The initial step in the Epley maneuver is the Dix Hallpike (DH) maneuver, a variation of which is also used in the Semont maneuver [Epley, 1992]. This is useful in diagnosis because it places the patient's eyes in a favorable position for viewing by the physician, and it is designed to trigger a particularly severe spell of nystagmus that is thus more easily observed. The posterior semicircular canal is most sensitive to ampullofugal movements (movement of fluid or particles in the stimulatory direction) and is much less sensitive to ampullopetal movements (the inhibitory direction). The DH causes ampullofugal fluid and particle movement in the posterior canal, maximizing the sensation of vertigo and the resulting nystagmus [Lanska and Remler, 1997]. It is useful to the operator during the Epley maneuver because the nystagmus is enhanced, because it allows diagnosis to take place at the start of a maneuver, and because it moves the particles in the direction of the canal exit. Only the latter is useful when self-applied by a patient, because in the absence of a viewer there is no benefit to maximizing nystagmus, which causes dizziness that can be severe enough to cause vomiting.

A second limitation is the possibility of horizontal canal BPPV (H-BPPV). After performing CRP successfully, the newly cleared particles are located just outside the opening to the common crus of the semicircular canals. If another DH is performed as one of a series of exercises, it is possible for these particles to reflux into the horizontal semicircular canal, creating H-BPPV [Foster et al., 2012]. This can occur in up to 9% of patients during performance of rapidly repeated maneuvers. When used in a specialty clinic, this is easily diagnosed and treated with H-BPPV maneuvers, but patients generally do not have the expertise to recognize differences in nystagmus indicating this disorder, nor are they trained in treatment maneuvers for it. Although this complication is infrequent, the vertigo and vomiting is severe enough to cause some patients to seek emergency care. This may limit the utility of the Epley maneuver as a home exercise. A 15-min wait between maneuvers reduces the risk of this complication and was used in this study.

The ideal home exercise should be able to be performed by the patient without an assistant. The Epley maneuver requires an operator and often a second assistant to guide the patient through the proper positions. It is possible to self-apply CRP without assistance [Radtke et al., 1999], but the sequence may be confusing when vertigo is also being experienced.

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We have devised a novel exercise, the half somersault (fig. 1) that is able to clear the causative particles from the semicircular canals but does not include the DH or require an assistant. Because it does not include the DH, this may reduce the risk of H-BPPV conversion. A secondary rationale was to reduce the dizziness experienced while the head is initially inverted, by allowing particles to move against the direction of fluid movement, which should slow their transition time and reduce cupular deviation compared to the DH. The head positions and corresponding particle positions are shown in figure 2 and the body positions we designed to achieve these head positions are shown in figure 1. The first three positions replace the DH. Although the remaining two body positions differ substantially from the Epley maneuver, the head motions are similar to those used when returning from the side-lying to the upright position in the Epley maneuver. Although we had long prescribed home exercises based on the Epley and Semont maneuvers for recurrences, after introducing this home exercise into our clinic in 2006, we noticed a decline in the number of patients returning with recurrences.

This study compares the Epley maneuver with the half somersault maneuver, when performed by patients as a self-treatment for posterior canal BPPV. We wished to determine whether the half somersault and Epley are equivalent in resolving acute nystagmus, discomfort during maneuvers, tendency for re-entry complications, and in efficacy as a home exercise.

Patients and Methods

This was a prospective, controlled, randomized, single-blinded clinical trial comparing the two exercises for BPPV.

The study was performed at a tertiary academic referral center from 2007 to 2010. Our institution has a weekly BPPV clinic. We see over 200 BPPV patients per year in this clinic and perform maneuvers on all patients with BPPV of either the horizontal or vertical canal varieties. Typically patients are treated with repeated maneuvers until symptom free at a single visit.

Inclusion criteria were as follows: 18 years of age or older; a history of symptoms suggestive of BPPV; nystagmus and axis of ocular rotation consistent with unilateral posterior canal BPPV. Diagnosis was performed by direct visualization of the globes during the DH maneuver.

Patients presenting with cupulolithiasis, H-BPPV, bilateral BPPV, or nystagmus of any other direction or stemming from other peripheral or central vestibular disorders were excluded. Patients with a history of BPPV symptoms but without visible nystagmus on DH were excluded. Exclusions included patients who were unable to bend the neck or turn the head safely, sit up, lie down, roll over or kneel on hands and knees, because these movements are required as part of the exercises. Patients unable to tolerate the DH or CRP, or who were unable to assume the half somersault position were excluded. All subjects gave informed consent according to a protocol approved by the Colorado Multiple Institutional Review Board (Principal Investigator C.A. Foster). The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration. Sixty-eight individuals were enrolled and completed the study, 49 females and 19 males.

A diagnostic DH was performed in a treatment room by the PI, and the presence and intensity of nystagmus was recorded using a 1–5 scale (nystagmus intensity score). Another researcher then removed the subjects to a training room, and assigned them via a randomized list prepared by a statistician to either the Epley or the half somersault maneuver. There is extensive literature evaluating the efficacy of the Epley maneuver (the current standard of

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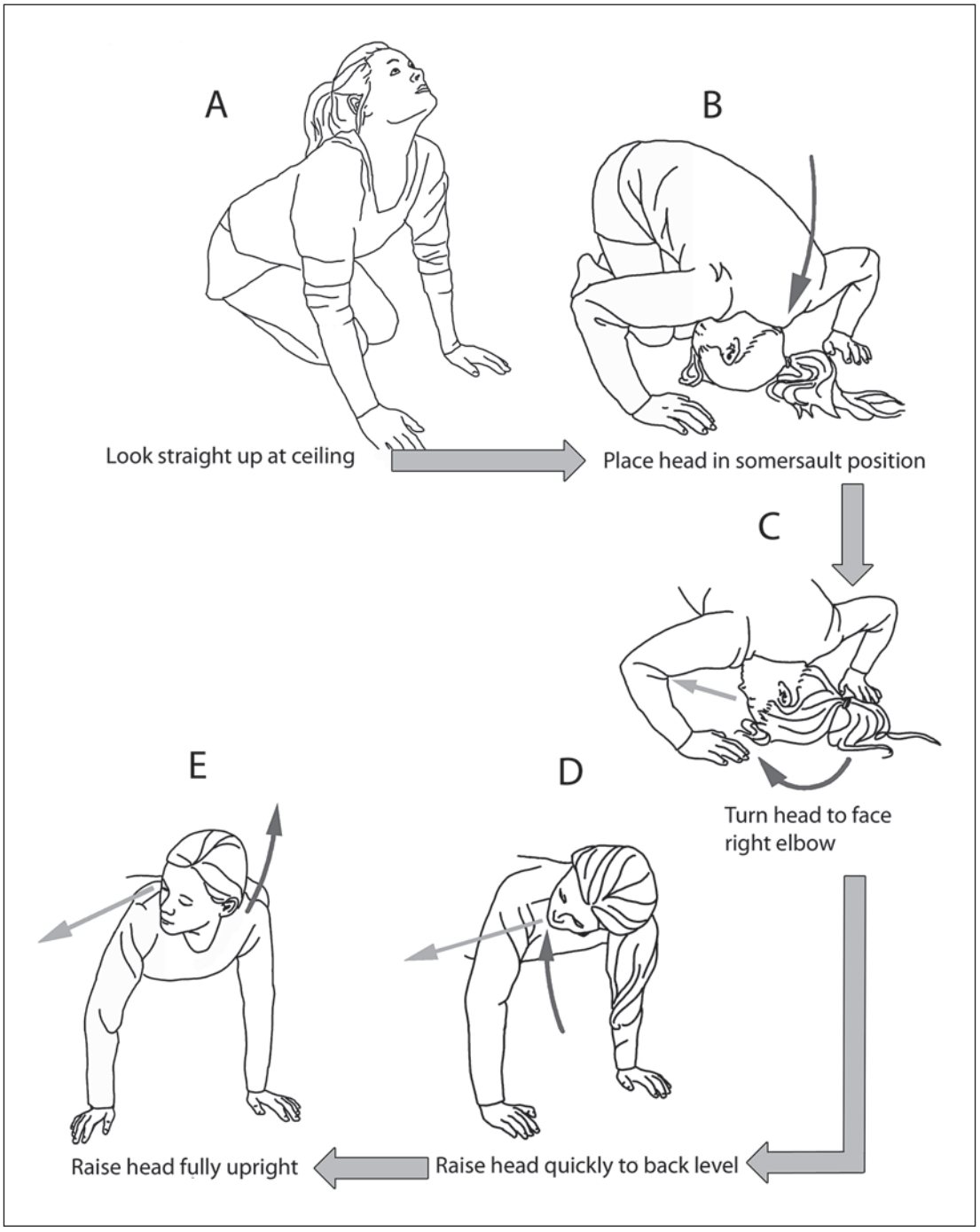

Fig. 1. Half somersault for right-sided BPPV. After each position change, any dizziness is allowed to subside before moving into the next position; if there is no dizziness, the position should be held for 15 s. **A** While kneeling, the head is quickly tipped upward and back. **B** The somersault position is assumed, with the chin tucked as far as possible toward the knee. **C** The head is turned about 45° toward the right shoulder, to face the right elbow. **D** Maintaining the head at 45°, the head is raised to back/shoulder level. **E** Maintaining the head at 45°, the head is raised to the fully upright position. Dark curved arrows show head movements. Lighter arrows near eyes show the direction one should be facing.

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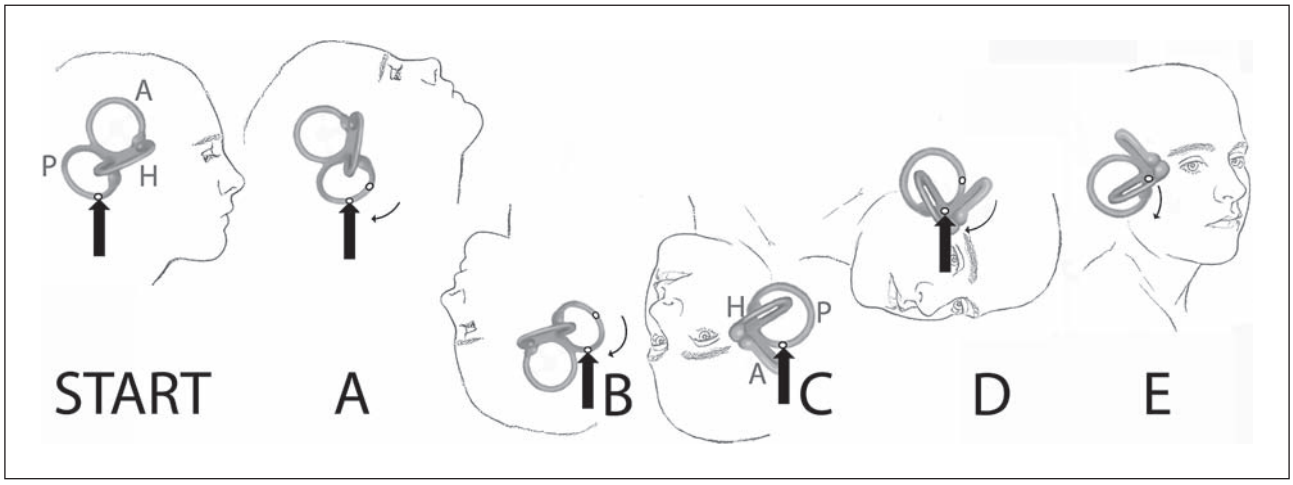

Fig. 2. Particle movement during half somersault. Head positions shown in **A–E** correspond to body positions in figure 1. A = Anterior canal, P = posterior canal, H = horizontal canal. Small arrows indicate the movement of particles as each position is assumed. In **E**, the small arrow indicates particles exiting to the utricle. Large bolded arrows in **A–D** indicate the final location of the particles for each position. The angle of view is 90° to the sagittal plane of the head and body in the starting position and in **A** and **B**. The posterior canal lies at approximately 50° outside of the sagittal plane and projecting toward the viewer as depicted. In **C–E** the head rotates 45° from the sagittal plane of the body and the labyrinth is depicted similarly rotated. This places the posterior canal near the sagittal plane of the body and allows maximal ampullofugal fluid movement as the head is raised. In **C**, with the head inverted, the plane of the horizontal canal is oriented at an upward angle. On repetition of the maneuver, any cleared particles in the utricle are unable to reflux into the horizontal canal during this step.

care) versus untreated controls. In this experiment, the controls were the patients receiving the Epley maneuver as a home exercise. The experimental group contained those self-treating with the half somersault maneuver. Thirty-five subjects were in the Epley group, and 33 in the somersault group. The subject was instructed in the selected maneuver verbally and with a handout and demonstration, and was observed performing it twice without physical guidance. Subjects were asked to rate the severity of the dizziness they experienced during their exercises on a 1–5 scale (exercise-induced dizziness score). A handout with written instructions and a diagram of the assigned exercise was given to the subject in a sealed envelope for later home use. This included instructions to wait 15 min between each maneuver performed to reduce the risk of canal conversion or re-entry. We expected that this would reduce the risk of horizontal canal conversion in the Epley group.

All patients then waited 15 min prior to returning to the original treatment room. The PI was blinded as to the maneuver type that the patient had learned and used. A DH was then performed by the PI, and the presence, duration and intensity of any remaining nystagmus was again recorded using a 1–5 scale.

To complete treatment and meet the standard of care, any patient with continued BPPV then received maneuvers by the PI (Epley) until they were free of nystagmus and experienced one DH without dizziness or nystagmus.

The subjects were provided with a log sheet to record recurrences and treatment results and were instructed to perform their assigned exercise with any recurrence. We defined a recurrence as a return of dizziness for which the patient applied the assigned exercise. This information was collected by mail and by telephone follow-up. All patients with a recurrence

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not responding to their assigned exercise were offered a return to one of our weekly BPPV clinics for standard treatments. We defined a treatment failure as a return to the clinic for dizziness after use of an exercise for recurrence, coupled with an abnormal DH in the treated ear on exam.

Six months after initial treatment, the log sheets were collected and each subject was contacted, their clinical chart was reviewed for recurrences, and they were questioned by telephone to verify log accuracy. 11/68 (16%) of the subjects were lost to follow-up, 6 in the half somersault group and 5 in the Epley group.

The half somersault and Epley groups were compared statistically by unpaired T test for initial nystagmus intensity and post-treatment nystagmus intensity. Paired T tests were used to compare pre- and post-treatment nystagmus intensity within each group. Exercise-induced dizziness scores, numbers of subjects with complete resolution of dizziness after two maneuvers, number of recurrences and treatment failures were analyzed by Fisher's exact test. A significance level of 0.05 was adopted.

Results

In the Epley group, the initial DH resulted in a nystagmus intensity of 3.51 ± 0.88 (mean ± SD). After two self-performed maneuvers, this declined to a post-treatment score of 1.11 ± 1.17, a 68% reduction in nystagmus intensity. This difference was significant ($p < 0.0001$). Subjects reported an exercise-induced dizziness score of 2.17 ± 1.20. 13/35 (37%) had a complete resolution of dizziness and nystagmus after performing their two observed maneuvers.

In the half somersault group, the initial DH resulted in a nystagmus intensity of 3.61 ± 0.97 (mean ± SD). After two self-performed maneuvers, this declined to a post-treatment score of 2.11 ± 1.57, a 42% reduction in nystagmus intensity. This difference was significant ($p < 0.0001$). Subjects reported an exercise-induced dizziness score of 1.61 ± 1.11. 9/33 (27%) had a complete resolution of dizziness and nystagmus after their two maneuvers. The complete resolution rate after two maneuvers did not differ significantly between the Epley and half somersault groups ($p = 0.271$).

The difference between pre-treatment nystagmus scores for the Epley and half somersault groups was not significant ($p = 0.684$). The post-treatment nystagmus scores in the Epley group were significantly lower than in the half somersault group ($p = 0.004$). The scores for exercise-induced dizziness were significantly lower in the half somersault group ($p = 0.049$).

The lowest possible score of 1 for exercise-induced dizziness was reported by 15/35 in the Epley group (43%) and 23/33 (70%) in the half somersault group and this difference was significant ($p = 0.023$). The highest scores of 4–5 for dizziness occurring during the exercise were reported in 7/35 (20%) of the Epley group and 4/33 (12%) of the half somersault group; this difference was not significant ($p = 0.291$).

During the 6-month follow-up period, 21 recurrences occurred in 15/30 (50%) of the subjects in the Epley group and 12 recurrences in 10/27 (37%) of the subjects in the half somersault group. Although there were fewer recurrences in the half somersault group, this difference was not significant ($p = 0.236$). 10/15 (67%) in the Epley group were able to resolve their recurrent symptoms using the home exercise; 3 returned to the clinic because they were unable to resolve their symptoms with the exercise, and 2 returned to the clinic and discontinued exercises due to H-BPPV. In the half somersault group, 9/10 (90%) were able to resolve their recurrent symptoms using the home exercise; one continued to have slight dizziness but did not feel it was severe enough to return to the clinic for it. None experienced H-BPPV. The half somersault group was significantly less likely than the Epley group to experience a treatment failure ($p = 0.034$).

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Discussion

The efficacy of the Epley maneuver has been demonstrated repeatedly and has led to its widespread use for the clinical treatment of BPPV [Epley, 2001]. The inclusion of the diagnostic DH at the start of the treatment maneuver makes it particularly useful to diagnosticians. For these reasons, it is the treatment of choice for posterior canal BPPV in our clinic and in many others.

Our study shows that both exercises are efficacious when used as a home exercise for patients, although neither is as effective as when the Epley is performed by an experienced operator. We typically resolve 84% of BPPV cases in two maneuvers [Foster et al., 2012], but the subjects in this study had a resolution rate of only 37% after two Epley maneuvers and 27% after two half somersaults. The half somersault was not as effective as the Epley in reducing nystagmus intensity with two maneuvers, an indicator of a reduction in particle burden in the posterior semicircular canal, and this difference was statistically significant. This suggests that patients may have to perform more half somersaults than Epley maneuvers to resolve an episode of BPPV.

However, the subjects reported more dizziness during the Epley than during the half somersault exercise and this difference was also statistically significant. The Epley group was significantly more likely to experience a treatment failure using home exercises for recurrences than the half somersault group, and only members of the Epley group discontinued using exercises, returned to the clinic for treatment, or experienced H-BPPV.

These results suggest that patients prefer the less effective exercise because they experience less dizziness when applying it and experience fewer complications. They are then able to repeat the exercise enough to resolve symptoms and so may not need to return to the clinic for treatment.

The half somersault can be performed on either the floor or in the center of a large bed, and so does not require that the patient be able to arise from the floor. However, it requires that the patient be able to assume the initial half somersault position, and so cannot be used by patients of excessive body weight, with knee, neck or back injuries, or with impaired flexibility.

Appendix

Instructions for half somersault for right-sided BPPV

A Kneel on the floor or in the middle of a large bed. Tip your head straight upward quickly until you are looking straight up at the ceiling. This may cause dizziness briefly.

B Next, place your head on the floor upside down, as if you are about to do a somersault. Tuck the chin so that your head touches the floor near the back of the head rather than near the forehead. This position may cause a burst of vertigo. Without moving, wait until any vertigo ends. The vertigo means the particles are moving in the proper direction. Tapping firmly on the skull with your fingertips just behind the right ear can help move the particles along.

C Slowly turn your head to face your right elbow. Try to center the right elbow in your field of view. You will keep your head turned to the right through the rest of the maneuver. Again, wait for any vertigo to end before moving to the next step.

D Keeping your head turned to the right and viewing your right elbow, QUICKLY raise your head to shoulder level. Your head should be positioned at about a 45° angle to the floor throughout this move. Vertigo is normal during this part of the procedure. Wait for the vertigo to end or count to 15 before continuing.

E Raise your head to the upright position QUICKLY, keeping it about halfway turned toward the right shoulder. Some additional vertigo may occur. After the vertigo subsides, slowly sit upright.

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Rest for 15 min. After the rest, quickly tip your head up and down. If no dizziness occurs, do not repeat the maneuver. If you still feel some dizziness when making that movement, repeat the maneuver. You may also repeat the maneuver if you have another vertigo spell in the future.

Additional instructions
Always wait at least 15 min between maneuvers to allow particles to settle.
Sleep propped up on 2 or 3 pillows for two nights following the maneuver.
Sleep only on your left side for a week after the maneuver (put a pillow behind you to keep you from rolling over in the night).

Disclosure Statement

No financial disclosures for any author.

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