

Strategies to Prevent Recurrence of Benign Paroxysmal Positional Vertigo

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Objective: To determine if a daily routine of Brandt-Daroff exercises increases the time to recurrence and reduces the rate of recurrence of benign paroxysmal positional vertigo (BPPV).

Design: Random sample of convenience and retrospective case review.

Setting: Tertiary referral center and outpatient clinic.

Patients: One hundred sixteen patients diagnosed with BPPV involving the posterior semicircular canal (BPPV-PC) who were successfully treated with the canalith repositioning procedure.

Interventions: Patients in the treatment group (n=43) performed daily Brandt-Daroff exercises, while patients in the no-treatment group (n=73) performed no exercises.

Main Outcome Measures: Follow-up was as long as 2 years. Every 2 months patients were mailed a ques-

tionnaire. If BPPV had recurred, patients contacted the principal investigator within 24 hours. Within 1 to 2 weeks, patients were evaluated in the clinic with the Dix-Hallpike maneuver or, if unable to travel to the clinic, interviewed by telephone.

Results: Symptoms recurred in 50 (43%) of the 116 subjects, 34 (47%) of 73 in the no-treatment group and 16 (37%) of 43 in the treatment group. There was no significant difference in the frequency of recurrence (Pearson χ^2 , $P=.33$) or time to recurrence (survival analysis, log-rank test, $P=.92$). A history of recurrent BPPV-PC did not affect frequency of recurrence (Pearson χ^2 , $P=.33$) or time to recurrence (survival analysis, log-rank test, $P=.72$).

Conclusion: Our results suggest that a daily routine of Brandt-Daroff exercises does not significantly affect the time to recurrence or the rate of recurrence of BPPV-PC.

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DIZZINESS IS A MAJOR PROBLEM of the elderly. In an inner-city geriatric population, 61% reported symptoms of dizziness.¹ The most common cause of dizziness in the elderly is benign paroxysmal positional vertigo (BPPV), accounting for 26% of all dizziness.² The incidence of BPPV increases with each decade of life,³ with the peak incidence occurring in the sixth and seventh decades of life.² Benign paroxysmal positional vertigo affects the quality of life of elderly patients. Elderly patients with unrecognized BPPV are more likely to have reduced activities of daily living scores, to have sustained a fall in the previous 3 months, and to be depressed.¹

Benign paroxysmal positional vertigo is a mechanical disorder of the inner ear characterized by brief periods of vertigo experienced when the position of the patient's head is changed relative to gravity. The brief period of vertigo is caused by abnormal stimulation of the dependent semicircular canal. Currently it is thought that most BPPV is caused by canalithiasis, free debris within the long arm of the semicircular canal.⁴ To alleviate the symptoms of BPPV, positioning maneuvers were developed to remove debris from the semicircular canals. One of these maneuvers, the canalith repositioning procedure,⁵ is designed to treat BPPV involving the posterior semicircular canal (BPPV-PC). The clinician moves the patient through a series

of positions. The success rate for a single treatment session is 78%.⁶ Another positional exercise is the Brandt-Daroff exercise.⁷ Patients perform 5 cycles of the exercise 4 times per day until no symptoms of vertigo are experienced for 2 consecutive days during their daily routine or with the exercises. The Brandt-Daroff exercises are often impractical because patients do not tolerate repeated provocation of symptoms. Brandt-Daroff exercises have a 23% to 98% success rate over a 1- to 2-week period.^{7,8}

Although treatment is presently very effective, BPPV often recurs. Forty-four percent of patients treated successfully with the canalith repositioning procedure redevelop BPPV within the first 2 years.⁶ Therefore, the purpose of this study is to determine if a daily routine of Brandt-Daroff exercises reduces the rate of recurrence of BPPV and increases the time for BPPV to recur. Prevention would improve the patient's quality of life and/or reduce the long-term cost of the medical management of BPPV.

METHODS

Subjects diagnosed with BPPV-PC and treated successfully with the canalith repositioning procedure were recruited from the practices of J.O.H. and T.C.H. This study was approved by the institutional review boards of Northwestern University, Chicago, Ill, and Midwestern University, Downers Grove, Ill.

To establish the diagnosis of BPPV-PC, a neuro-otologic examination was performed. The patient's response to the Dix-Hallpike maneuver was evaluated using a video Frenzel system (RealEyes; Micromedical Technologies, Chatham, Ill). Three criteria were required for diagnosis: (1) a 1- to 20-second latency before the onset of vertigo and nystagmus, (2) observation of a rotatory and/or upward-directed nystagmus in the head-hanging position, and (3) vertigo and nystagmus less than 60 seconds in duration. If BPPV was confirmed, patients were treated with the canalith repositioning procedure with or without vibration as previously described.^{6,9} After the maneuver, patients remained seated in the office for 20 minutes. Patients were given verbal and written instructions to sleep semirecumbent for 48 hours and to avoid rapid head movements, extreme flexion and extension of the neck, and positions that provoke symptoms of vertigo, such as placing the involved ear in a dependent position while sleeping, for 1 week.

One week following treatment, the patient's response to the Dix-Hallpike maneuver was evaluated in the clinic. A random sample of convenience was obtained. If patients were cured or much better and agreed to perform the Brandt-Daroff exercises daily, they were placed in the treatment group. If patients were unable to perform the exercises because of physical limitations or lack of motivation, they were placed in the no-treatment group. To increase the number of participants in the no-treatment group, we performed a retrospective chart review to identify patients previously treated for BPPV. Patients recruited through the chart review were either reevaluated in

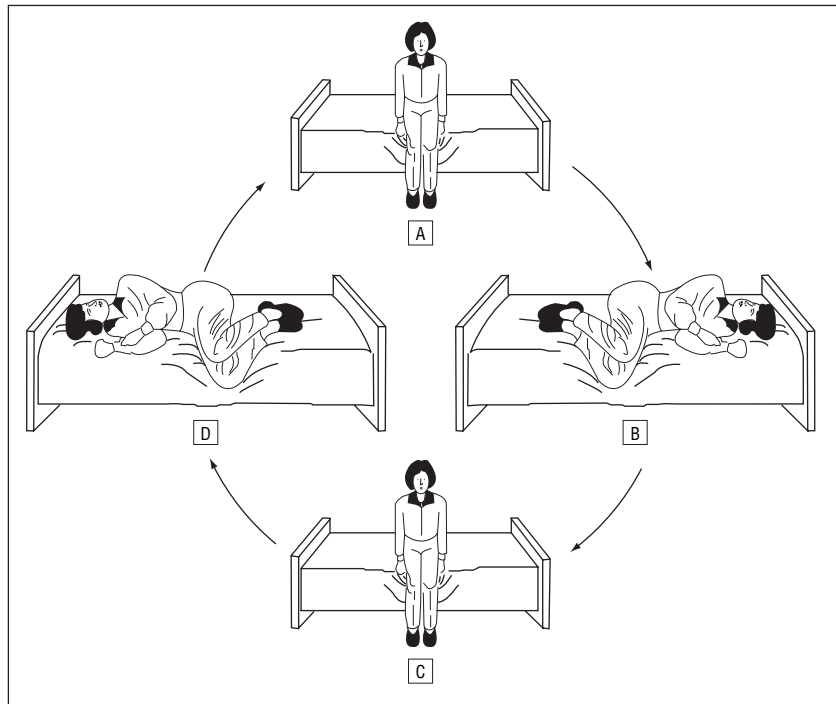


Figure 1. Brandt-Daroff exercises. Each position was maintained for 30 seconds.

the clinic or interviewed by telephone. If reevaluated in the clinic, the patient's response to the Dix-Hallpike maneuver was evaluated. If interviewed by telephone, the patient was instructed to initiate the head or body movement that had previously provoked the symptoms and to report the outcome. Patients were interviewed by telephone if they worked during the day and were unable to take time off from work or if they were from an outlying community and returning to the clinic presented a hardship. Of the patients recruited through the chart review, 49% (n=30) were reevaluated in the clinic while 51% (n=31) were interviewed by telephone.

The patients quantified their symptom intensity on a scale of 1 to 3 (mild, moderate, or severe) prior to the treatment procedure and at the time of follow-up. Results, defined as change, were categorized on a scale of 1 to 4 (cure, much better, better, or no change) based on clinical examination or as reported by telephone at the time of follow-up. If cured or much better, patients were asked to participate in the study and consent was obtained. Patients were excluded from the study if the diagnosis of bilateral BPPV-PC or atypical BPPV was established, if central nervous system involvement was identified based on history, magnetic resonance imaging, or findings of neurological examination, or if an alternative maneuver was performed, such as the Semont maneuver¹⁰ or Brandt-Daroff exercises.⁷

Subjects in the no-treatment group did not perform exercises. Those in the treatment group were trained in and instructed to perform the Brandt-Daroff exercises.⁷ Subjects were asked to perform 2 cycles once a day for 2 years. In the Brandt-Daroff exercises the patient moves through a series of 4 positions as illustrated in **Figure 1**, A-D. To begin, the patient is seated on the edge of the bed and the head/neck is rotated 45° toward the right (Figure 1, A). The patient rapidly moves into the left side lying position, maintaining the head/neck rotation (Figure 1, B). The patient then rapidly sits up with the head slightly flexed forward (Figure 1, C). The exercise is repeated toward the opposite side (Figure 1, C, D, A). This constitutes 1 cycle of the exercise. Each position is maintained for 30 seconds, the total time being 2 minutes. Subjects were given an illustrated handout of the Brandt-Daroff exercises.

Table. Characteristics of Subjects With Benign Paroxysmal Positional Vertigo

Characteristic	No Treatment (n = 73)	Treatment (n = 43)	Total Population (n = 116)	Statistical Test	P
Age, mean ± SD (median), y	56 ± 16 (58)	59 ± 15 (57)	57 ± 16 (58)	<i>t</i>	.45
Male/female, No.	22/51	10/33	32/84	Pearson χ^2	.42
Duration, mean ± SD (median), mo	12 ± 26 (4)	11 ± 22 (3)	12 ± 24 (3)	Kruskal-Wallis	.49
Intensity, No. (%)*				Pearson χ^2	.04
Unknown	0 (0)	1 (2)	1 (1)		
Mild	25 (34)	8 (19)	33 (28)		
Moderate	36 (49)	31 (72)	67 (58)		
Disabling	12 (16)	3 (7)	15 (13)		
History of recurrence, No. (%)†				Pearson χ^2	.50
No	43 (62)	24 (56)	67 (60)		
Yes	26 (38)	19 (44)	45 (40)		
Response after treatment, No. (%)				Pearson χ^2	.59
Cure	60 (82)	37 (86)	97 (84)		
Much better	13 (18)	6 (14)	19 (16)		
Better	0 (0)	0 (0)	0 (0)		
No change	0 (0)	0 (0)	0 (0)		

*Because of rounding, percentages may not total 100%.

†Total population, 112 subjects.

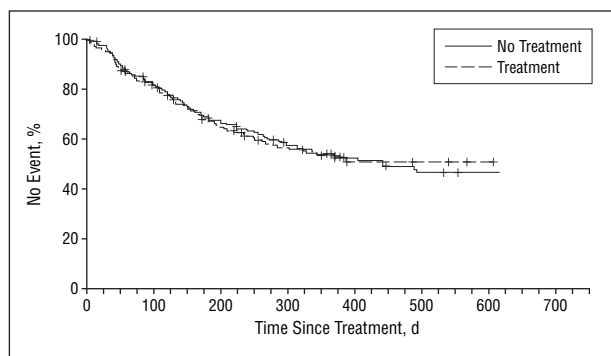


Figure 2. Kaplan-Meier estimation of time to recurrence for the treatment and no-treatment groups (log-rank statistic, 0.02; $P = .92$).

Both groups were instructed to notify an investigator within 24 hours if dizziness recurred. Every 2 months subjects were mailed a questionnaire asking if dizziness had recurred and, if in the treatment group, if they were still doing their exercises. If dizziness had recurred, subjects were evaluated in the clinic with the Dix-Hallpike maneuver and eye movements were videotaped with the video Frenzel system within 1 to 2 weeks of the time of recurrence as scheduling permitted. The patients quantified their symptom intensity on a scale of 1 to 3 (mild, moderate, or severe). If BPPV did not recur, subjects were evaluated in the clinic at the end of the study.

Statistical analysis of the data was performed using Systat version 8 (Systat Software, Point Richmond, Calif). The level of significance for all analyses was $P < .05$.

RESULTS

We identified 116 patients with BPPV-PC. Forty-three patients were assigned to the treatment group and 73 to the no-treatment group. Fifty-five patients were identified from a random sample of convenience and were treated between December 25, 1998, and August 26, 2003. Forty-three (78%) were assigned to the exercise group and 12 (22%) were assigned to the no-exercise group. Sixty-one subjects were identified from a random

chart review and were treated between July 1991 and December 1997. The **Table** summarizes the demographic characteristics of the groups. There were no significant differences in age, sex, duration of symptoms prior to treatment, or history of recurrent BPPV. There was no significant difference in response to treatment; 60 patients (82%) in the no-treatment group were cured and 37 patients (86%) in the treatment group were cured.

Symptoms recurred in 50 patients (43%) in the total population, in 34 patients (47%) in the no-treatment group, and in 16 patients (37%) in the treatment group. The difference in frequency of recurrence between the two groups was not significant (Pearson χ^2 , $P = .33$). To determine whether the time to recurrence differed between the treatment and no-treatment groups and to account for patients entering the study at different times, the Kaplan-Meier product-limit method was used to estimate the survival function. Survival time was defined as the number of days from the day of the last treatment session to the day the symptoms of BPPV recurred. For patients without a recurrence of BPPV, times were censored at the last day of follow-up. The estimated survival function for the treatment and no-treatment groups was plotted (**Figure 2**). This figure shows that patients who did the Brandt-Daroff exercises had a longer time until recurrence than patients who did no exercises. However, the log-rank test revealed that there was no significant difference ($P = .92$).

Once it was determined that there was no significant difference in the rate of recurrence between the two groups, the data were stratified to determine whether the age of the patient covaried with the time to recurrence of BPPV. Surprisingly, age did not correlate significantly with the time to recurrence as determined by the Kaplan-Meier product-limit method and log-rank test ($P = .63$).

To determine if there was a difference between the current and historical data the new group of 55 subjects was analyzed separately. There was a trend favoring exer-

cise. In the exercise group, 16 (37%) had a recurrence, and in the no-exercise group, 7 (58%) had a recurrence. Again, there was no significant difference between the two groups in the frequency of recurrence (Pearson χ^2 , $P = .19$) or the time to recurrence (survival analysis, log-rank test, $P = .36$).

We also examined whether history of recurrent BPPV significantly affected the frequency of recurrence of BPPV in the treatment and no-treatment groups. Based on the patients' history prior to treatment, patients were classified into two categories, recurrent BPPV or one episode of BPPV. Recurrent BPPV was defined as sporadic periods of BPPV symptoms over time, while one episode of BPPV was defined as continuous BPPV symptoms over time. Of the 116 patients available for analysis, 112 had adequate documentation to determine if they had recurrent BPPV or one episode of BPPV (Table). There was no significant difference in the frequency of recurrence (Pearson χ^2 , $P = .11$; Fisher exact test, $P = .15$) or the time to recurrence (survival analysis, log-rank test, $P = .20$) between subjects with a history of recurrent BPPV and those with one episode of BPPV with continuous symptoms.

To determine the impact on recurrence of exercise and history of recurrent BPPV, the 112 subjects were differentiated by history of recurrent BPPV (Figure 3). In both the treatment and no-treatment groups, patients with no history of recurrent BPPV had a recurrence less often than patients with a history of recurrent BPPV. However, the difference between groups was not significant (Pearson χ^2 , $P = .33$). The treatment group with no history of recurrence had the lowest rate of recurrence; BPPV recurred in 7 (29%) of the 24 subjects. The no-treatment group with a history of recurrence had the highest rate of recurrence; BPPV recurred in 14 (54%) of the 26 subjects. The observed differences in percentages between groups were not significant (Cochrane test for linear trend, $P = .14$) because of small sample sizes. Nine (47%) of the 19 subjects in the treatment group with a history of recurrence and 17 (40%) of the 43 subjects in the no-treatment group with no history of recurrence had a recurrence of BPPV. The time to recurrence of BPPV was not significantly different between the groups (survival analysis, log-rank test, $P = .72$).

COMMENT

Our results suggest that a daily routine of Brandt-Daroff exercises does not affect recurrence of BPPV-PC. There was no significant difference between the treatment and no-treatment groups in the rate of recurrence or the time to recurrence of BPPV-PC (Figure 2, $P > .05$). Age and history of recurrent BPPV prior to initial treatment with the canalith repositioning procedure did not correlate with rate of recurrence. These results differ from those of Amin et al,¹¹ who found that daily Brandt-Daroff exercises prevented recurrence of BPPV-PC. We suggest that this difference is due to the limited number of subjects in the study by Amin et al (exercise group, $n = 10$; no exercise group, $n = 7$).

The absence of a significant difference between the treatment and no-treatment groups suggests either that

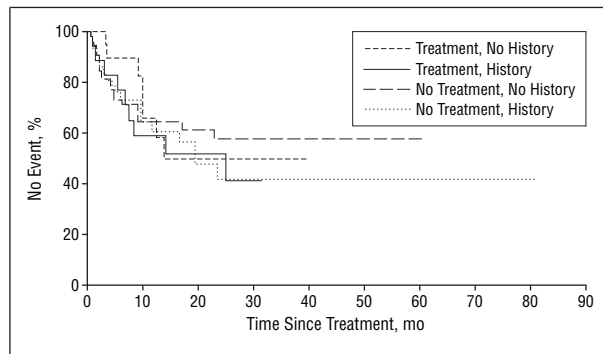


Figure 3. Kaplan-Meier estimation of time to recurrence for the treatment and no-treatment groups. Subjects were differentiated by history vs no history of recurrent benign paroxysmal positional vertigo (log-rank statistic, 1.35, $df = 3$; $P = .07$).

the Brandt-Daroff exercises have such a small effect that it is not detected with our sample size or that the exercises are not effective. We suggest that a daily routine of the home canalith repositioning procedure may be more effective than the Brandt-Daroff exercises for preventing BPPV-PC. After 1 week of exercising, the success rate of the Brandt-Daroff exercises was 23%,⁸ compared with 67% for the home canalith repositioning procedure.⁸ If the home canalith repositioning procedure is more effective than the Brandt-Daroff exercises following 1 week of treatment, then the home canalith repositioning procedure may be more effective for preventing recurrence of BPPV-PC.

Our noncompliance rate may have biased the results of the study in favor of the no exercise group. Eleven (26%) of the 43 subjects in the exercise group stopped exercising and were then dropped from the study. Nine stopped exercising because they no longer had symptoms of vertigo and therefore were not motivated to do the exercises, and 2 stopped exercising due to unrelated new medical conditions.

Recurrence of BPPV may be caused by some other process that is not affected by exercise, such as reactivation of a latent virus infection—for example, herpes simplex virus type 1 infection. Current evidence suggests that the cause of vestibular neuritis is a latent infection of the vestibular ganglia by herpes simplex virus type 1.¹² A stressful life event may result in reactivation of the latent virus infection, which could manifest as BPPV.^{12,13} If the cause is viral, exercise would not prevent recurrence of BPPV.

In summary, the observed trend was that subjects in the treatment group had fewer recurrences than subjects in the no-treatment group and that subjects with no history of BPPV had fewer recurrences than subjects with a history of recurrent BPPV. However, the observed trend was not significantly different between the groups; therefore, a daily routine of Brandt-Daroff exercises does not affect the time to recurrence of BPPV or the rate of recurrence of BPPV.

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