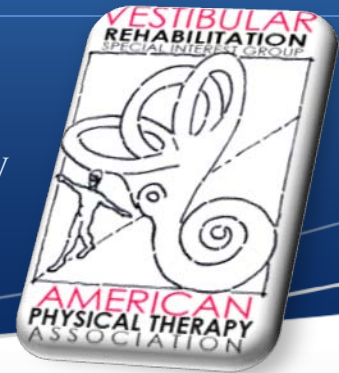


Vestibular Rehabilitation SIG

American Physical Therapy Association/Neurology Section

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Message from the Chair

Susan L. Whitney, PT, PhD, NCS, ATC, FAPTA
Vestibular SIG Chair

This benign paroxysmal positional vertigo (BPPV) special edition is very timely. Just recently an entire book was published related to the topic of the pathophysiology, anatomy, and interventions that are available to treat the person living with BPPV.¹ Dr. Barany's clear description of BPPV in the 1920's was a hypothesis in the medical community at the time. It was only in the late 80's and early 90's that people started believing that BPPV really existed. Dr. John Epley's work was what broke the field open in the United States with his creation of the Epley maneuver to treat BPPV.²⁻⁵ Dr. Epley was profoundly criticized for his early work in the treatment of persons with BPPV, yet later won the Barany prize for his groundbreaking treatments for persons living with BPPV. Through his work, Dr. Epley changed the treatment of BPPV in the United States and the world with his unique idea about relocating the otoconia from within the semi-circular canals.

A recent search on PubMed (8/6/12) of the key words BPPV revealed 632 citations, of which 20 were published before 1990. The literature related to BPPV has grown exponentially over the past 22 years. Physical therapists have become key providers of the BPPV maneuvers because of our unique background and knowledge base. Our understanding of anatomy and physiology of the vestibular system, knowledge of medical co-morbidities and basic/clinical sciences, and our ability to treat the entire person (neuromuscular, cardiovascular and musculoskeletal systems) make the physical therapy profession uniquely qualified to treat persons who have BPPV and their co-morbid balance disorders.

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Practice Guidelines for BPPV as described by the medical community

Heather Dillon Anderson, PT, DPT, NCS
Neumann University

In 2008 the American Academy of Neurology (AAN) as well as the American Academy of Otolaryngology-Head and Neck Surgery Foundation (AAO-HNS) published clinical practice guidelines for treating persons with benign paroxysmal positional vertigo (BPPV). In both cases the guidelines were intended to help standardize best practice techniques for treating BPPV and were based on extensive reviews of the existing literature. The recommendations were ultimately based on the quality of the research examined. The AAN did not specify who the guidelines were intended for, but the AAO-HNS described its audience as being “all clinicians who are likely to diagnose and manage adults with BPPV” and described the guidelines as being intended to “improve the quality of care and outcomes for BPPV.” (Bhattacharyya et al, 2008) After reviewing the practice guidelines described by both the AAN and AAO-HNS, the intent of this article is to summarize the findings and describe the clinical relevance to practice.

BPPV occurs when calcium carbonate crystals, called otoconia, become dislodged from the structures that contain them (the utricle and saccule) and create a current of endolymph within the affected semicircular canal. Because the otoliths are dense, head movement causes them to move within the canals and creates symptoms of vertigo and nystagmus. Typically there are two types of BPPV described: canalithiasis, which occurs when the otoliths are free floating in the canal and cupulolithiasis, which occurs when the otoliths adhere to the gelatinous region (the cupula) within one of the canals. Canalithiasis is the more common type of BPPV and is thought to respond better to treatment because the otoliths are free floating. Neither practice guideline specifically described which type of BPPV the research was referring to. BPPV may occur in any of the three semicircular canals of the inner ear: anterior (superior), posterior and horizontal (lateral). Both practice guidelines identified posterior canal as being the most common and anterior the least. Because anterior canal BPPV is least common there was insufficient evidence found by either review to create guidelines for this type of BPPV.

BPPV has a lifetime prevalence of 2.4% and is

described as the most common vestibular disorder in adults (Bhattacharyya et al, 2008), (Fife et al, 2008). Furthermore, the recurrence rate for BPPV is described as being 10-18% one year after treatment, 37-50% five years after treatment, and an overall recurrence rate of 15% per year (Bhattacharyya et al, 2008). The age of onset for BPPV is most common between the ages of 50 and 70. According to Oghalai et al, (2000), approximately 9% of elderly patients undergoing comprehensive geriatric assessment for non-balance complaints fail to be tested for BPPV. Because BPPV causes vertigo, many persons with this condition also have balance impairment and subsequently may have an increased risk of falling, especially in the aging population. Proper diagnosis and treatment of BPPV is essential to reduce symptoms of vertigo and prevent falls, which can lead to debilitating and costly secondary health complications.

The first step in adequate management of BPPV is diagnosing the condition. The AAO-HNS describes the diagnosis of posterior semicircular when two conditions are present: (1) the patient reports a history of vertigo associated with changes in head position and (2) the Dix-Hallpike test provokes the characteristic nystagmus described for this condition. The nystagmus described for posterior canal BPPV is up-beating and torsional with the fast phase beating toward the side being tested.

To complete the Dix-Hallpike test the patient is first positioned in a long sitting position, next the examiner rotates the head 45 degrees and quickly moves the patient into a supine position with the neck extended 20 degrees beyond the horizontal plane. While in this position, the examiner observes the person's eyes for nystagmus, specifically the duration and direction. Finally the person is returned to the long sitting position and the other side is tested. The research completed by the AAO-HNS confirmed that the Dix-Hallpike test continues to be the “gold standard” for diagnosing posterior canal BPPV; with a “strong recommendation” for use described. However this evidence was described as being Grade B, which indicates that there were minor limitations in the studies examined. (For definitions of the Grade levels of evidence refer to the table at the end of the article.)

BPPV Practice Guidelines (cont.)

Notably, Hanley and O'Dowd (2002) reported a positive predictive value of 83% and negative predictive value of 52%. A negative predictive value this high indicates that a negative Dix-Hallpike does not always rule out the diagnosis. In addition, patient exclusions described for this guideline include: persons with physical limitations including cervical stenosis, severe kyphoscoliosis, limited cervical range of motion, Down syndrome, severe rheumatoid arthritis, cervical radiculopathies, Paget's disease, ankylosing spondylitis, low back dysfunction, spinal cord injuries and morbid obesity.

Once a positive diagnosis of posterior canal BPPV is established, there are options for treating this condition. Based on the research examined, both the AAN and the AAO-HNS concluded that the canalith repositioning procedure (CRP) (also called the canalith repositioning maneuver, the Epley without vibration and canalith repositioning technique) is the most effective treatment option and should be offered to persons of all age diagnosed with this type of BPPV. This recommendation was described by the AAN as being Level A; there was sufficient high quality research to back the recommendation without reservation. The CRP begins in the same position the Dix-Hallpike ends. Once the nystagmus subsides, the examiner waits at least 30 seconds and then rotates the head 90 degrees toward the other side and again holds the position until the nystagmus subsides plus 30 seconds. Next, the examiner rolls the patient on to their side, tucks the chin and holds this position for the same parameters. Finally the patient is assisted in to a sitting position, coming up with the chin tucked.

The other treatments examined by both the AAN and the AAO-HNS included "observation" of the condition which involved watching the person diagnosed with BPPV for complications and waiting for a spontaneous resolution. Two other treatments described were the Semont (Liberatory), which is a more rapid maneuver typically described for cupulolithiasis and Brandt-Daroff exercises. The AAN concluded that the Semont maneuver was the next most effective treatment for posterior canal BPPV but described the evidence for this treatment as being Level C

and classified as only "possibly effective" due to the limited amount of research. The Brandt-Daroff exercises were found to be significantly less effective than both the CRP and Semont maneuver.

The AAN also investigated the efficacy of using mastoid vibration during a CRP when treating posterior canal BPPV as originally described by the Epley maneuver in 1992. After examining one Class II study, one Class III study and three Class IV studies, the conclusion was that "mastoid oscillation is probably of no added benefit to patients treated with CRP for posterior canal BPPV." (Level C recommendation) (Fife et al, 2008)

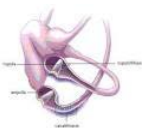


If the Dix-Hallpike test is completed and negative or if both sides tested produce nystagmus purely horizontal in nature, the diagnosis of lateral (horizontal) canal BPPV should be explored.

The incidence of horizontal canal BPPV accounts for between 10-17% cases of BPPV (Fife et al, 2008). The supine roll test (Pagnini-McClure maneuver) is typically used to diagnose this type of BPPV. To complete the roll test, the patient is positioned supine, the examiner lifts the head and quickly rotates it 90 degrees. Both sides are tested in this fashion. At the end of the test position the eyes are observed for nystagmus. If the lateral canals are affected, the nystagmus will beat either toward the uppermost ear (apogeotropic nystagmus), indicative of cupulolithiasis; or down toward the undermost ear (geotropic nystagmus), indicative of canalithiasis. A subjective report of vertigo during the test must be present to confirm the diagnosis and is used to guide the treatment.

The AAN did not provide a recommendation regarding the use of the roll test to diagnose horizontal canal BPPV. The AAO-HNS examined the existing research behind this test and recommended its use but described the evidence

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It's time to consider other signs and tests to determine side of involvement in Horizontal Canal BPPV!

Anne K. Galgon, PT, PhD, NCS
Vestibular SIG Vice Chair

The May topic of the Vestibular SIG Abstract of the Week focused on Horizontal Canal (HC) BPPV. Four of the abstracts presented addressed clinical findings and tests to enhance diagnosis of side of involvement in HC BPPV¹⁻⁴. Over the last 10 years, many research publications have described ways to assist in the diagnosis of side of involvement in HC BPPV. However, this information has not been integrated well into physical therapy practice. The standard recommendation to diagnosis HC BPPV for entry-level physical therapists and specialists in vestibular rehabilitation continues to be a single positional test, the **Supine Roll Test**⁵⁻⁷. This test may not effectively diagnosis side of involvement in all patients with HC BPPV. When a therapist cannot determine side of involvement they may take longer to apply the most appropriate canalith repositioning maneuver (CRM) and patients will require more physical therapy sessions and experiences longer durations of active BPPV before symptoms are resolved. If physical therapists are to be recognized as clinical practitioners who effectively manage BPPV, they must be current on developing diagnostic procedures and interventions in managing HC BPPV. The purpose of this review is to describe the various signs and positional tests that have been presented in the literature and discuss how physical therapists could implement them in the examination of individuals with suspected BPPV.

There may be several reasons why educators do not present this information when training physical therapists in vestibular rehabilitation. One argument is that the frequency that HC BPPV will be seen in the clinic is low. The percentage of HC BPPV in all patients seen with BPPV has been reported as low as 5%⁶ and as high as 27%⁸ but is probably more likely between 10 and 12%^{9,10}. Even if only 1 in 10 patients with BPPV have horizontal canal involvement, it is very likely that physical therapy practices specializing in vestibular rehabilitation will see these patients. Other considerations may be that the Supine Roll Test can determine side of involvement in the majority of cases and adding additional diagnostic procedures will take additional time or may be too confusing for physical therapists to interpret. This

review will show that the diagnostic algorithms that have been created are consistent in the literature, and most tests do not take much additional time and are not hard to understand or apply.

Table 1 presents the standard diagnostic methods used to determine the canal, the type (canalithiasis verse cupulolithiasis) and side of involvement traditionally used in physical therapy practices. In the **Supine Roll Test** (SRT) the patient lies in supine with neck flexed 30 degrees to align the horizontal canals into the gravitational field. The head is then quickly rotated 90 degrees to the right and the eyes are observed for either geotropic



(towards the ground) or apogeotropic (away from the ground) nystagmus. The head is then brought back to facing upward, and then quickly rotated to the left 90 degrees. Because of the relationship of the two HCs to

gravity in supine, when otoconia are present, nystagmus will be provoked on both the right and left rotations and the direction (geotropic or apogeotropic) will be the same in each head rotation. The side of involvement is determined by the intensity of the nystagmus and symptoms, because the fluid dynamic effect of the otoconia on the cupula will be different in the right and left roll. Theoretically, the response is explained by Ewald's Second Law that states that the system can be excited more than it can inhibited. There will be a greater response when otoconia move toward the ampulla (ampulopetal) and the system is excited than when they are displaced away from the ampulla (ampulofugal) and the system is inhibited. In the geotropic form of HC BPPV, the otoconia will be displaced toward the ampulla when rotating to the involved side, thus more intense nystagmus. In the apogeotropic form, otoconia will be displaced toward the ampulla when rotating away from the side of

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Stop the world, I want to get off

Vestibular Neurophysiology of Horizontal Semicircular Canal BPPV

Michael C Schubert, PT, PhD
Johns Hopkins Medicine

Benign Paroxysmal Positional Vertigo (BPPV) affecting the horizontal semicircular canal (hSCC) is not as uncommon as earlier estimates. Larger sample size studies ($n > 200$) investigating the incidence of horizontal canal BPPV – verified from nystagmus recording or observation, confirm BPPV affects the hSCC from **10 to 31%** (De la Meillieure et al 1996; Prokopakis et al 2005; Moon et al 2006).

FUNDAMENTAL FACT:

In hSCC BPPV, the nystagmus is *always* more intense when it is beating toward the affected ear (regardless of geotropic or apogeotropic).

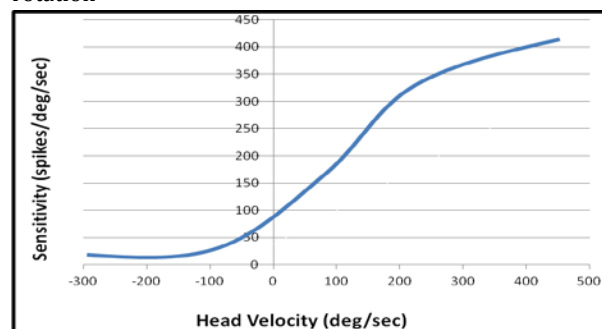
The challenge in diagnosing hcBPPV is determining the affected ear. Various clinical tests exist to test the HC for BPPV, though that is not the intent of this article. Instead, we will focus on the anatomy and physiology explaining the nystagmus patterns associated with hSCC-BPPV and how to use that to determine the affected side. As is the case for the vertical semicircular canals, two types of BPPV afflict the hSCC; canalithiasis and cupulolithiasis. The predominate feature distinguishing these unique forms is the duration of the nystagmus. Critical too is the direction of the nystagmus, though direction alone can mislead the clinician. Geotropic hSCC-BPPV is characterized by nystagmus beating towards the ear that is closest to earth when the head/body is positioned in side lying (McClure 1983; Baloh et al 1993). This is believed to be caused by free floating otoconia inside the endolymph of the HC and is termed canalithiasis (Baloh et al 1993; Lempert 1994). Apogeotropic (ageotropic) HC BPPV is characterized by nystagmus that beats away from the ear closest to earth when the head/body is positioned in side lying (Baloh et al 1995; Casani et al 1997; Fife TD 1998). This nystagmus pattern can be caused by otoconia attached to the cupula (cupulolithiasis) or from otolithic debris freely floating but located in the anterior arm of the HC near the cupula (in which case it would be labeled as canalithiasis) (Nuti 1998).

Critical to understanding the physiology behind the nystagmus is to know the work of 37 year old Dr J—

this would be Dr Julius Richard Ewald. Dr Ewald was a German physiologist at the University of Strasbourg best known for his research on the flow of endolymph within the pigeon's semicircular canals and related effect on the eyes (Ewald 1892). He is credited with establishing the important excitation-inhibition asymmetry, which states an ampullopetal endolymph movement causes a greater stimulation than an ampulofugal one (Ewald's 2nd law). Recall that vestibular afferents from each semicircular canal can be inhibited or excited depending on the flow of endolymph. The ampulla of each SCC is the bulbar ending of the SCC adjacent to the utricle; it houses the sensory epithelial cells and cupula. For ease, the word ampullo can be substituted with utriculo to give a clearer reference point for the flow of endolymph. Utriculopetal (ampulopetal) flow is towards the utricle (cupula) and therefore excitatory for the horizontal SCC. Utriculofugal (ampulofugal) flow is away from the utricle (cupula) and therefore inhibitory for the same horizontal SCC.¹ This means that head rotation in the excitatory direction of a canal elicits a greater response (afferent firing rate is higher) than does the same rotation in the inhibitory direction (**Figure 1**).

¹ The opposite is true for the vertical semicircular canals (Ewald's 3rd law).

Figure 1. Left vestibular afferent sensitivity to head rotation



The resting firing rate of the mammalian vestibular afferents is ~ 90 spikes/sec. Their sensitivity to head rotation is ~ 0.5 spikes/deg/sec (Goldberg and Fernandez 1971; Lysakowski et al 1995). The resting firing rate enables each vestibular system to detect head rotation in either direction, with preference for rotations on the side of the afferent. In this figure, the range of sensitivity for the left vestibular afferents for leftward (positive) rotations is greater than rotations to the right, because of the inhibition-excitation asymmetry.

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Differential Diagnosis and Treatment of Anterior Canal Benign Paroxysmal Positional Vertigo

Janet Odry Helminski, PT, PhD
Midwestern Univeristy

Benign Paroxysmal Positional Vertigo (BPPV) may involve 1 or more of the 3 semicircular canals. Of the 3 canals, the anterior canal (AC) is least often affected due to the AC's anatomically superior position during most activities and the descent of the long arm directly into the common crus and vestibule resulting in debris self-clearing. The incidence of AC-BPPV is reported at 1.5-19% of BPPV cases¹⁻³. Differential diagnosis and treatment of AC-BPPV is difficult due to the canal plane orientation, the relative canal position, and the radii of curvature of the AC. The purpose of this review is to discuss the differential diagnosis of AC-BPPV and to describe particle repositioning maneuvers designed to treat the AC-BPPV.

Anatomical Comparison of the Vertical Canals

The anatomical alignment of the AC is very different than the posterior canal (PC) and creates challenges in identifying and managing AC-BPPV. The relative position of the initial ampullary segment to the vestibule is superior for the AC and inferior for the PC (Figure 1). In the upright position, the initial ampullary segment of the AC is roughly vertical (70° with respect to the earth horizontal) while the ampullary segment of the PC is approximately 20° below the earth horizontal⁴. The near vertical initial ampullary segment of the AC alters the radii of curvature of the AC hindering otoconia from clearing the long arm of the AC. In BPPV, activation of

a canal generates a nystagmus that is in the plane of the canal⁵. In the upright position, using the Reid stereotaxic coordinate system, the AC is 41° from the sagittal plane while the PC is 56° from the sagittal plane⁶. The pattern of nystagmus reflects canal placement because the rotational axis of the nystagmus is orthogonal to the plane of the canal⁵. Therefore, the vector of ocular nystagmus from the AC is primarily downbeating with little or no torsion while the vector of ocular nystagmus from the PC is primarily torsional (superior pole directed towards the involved ear) and upbeat⁵. The differences in anatomical alignment between the AC and PC need to be considered during positional testing and particle repositioning maneuvers.

Differential Diagnosis of BPPV

To formulate a physical therapy differential diagnosis, a thorough history and neurologic examination is performed to identify BPPV from other potential causes of positional vertigo such as orthostatic hypotension, low spinal fluid pressure, and brainstem or cerebellar dysfunction. Cervical spine and vertebral artery screening tests should be included prior to positional testing to identify limitations and potential contraindications to performing the positional tests. Once the cervical spine and vertebral artery are cleared, positional testing is performed.

History of BPPV

The diagnosis of AC-BPPV is based on history and clinical findings on positional testing – both subjective and objective⁷. The history is critical in the formation of a differential diagnosis. From the history alone, BPPV is detected with a specificity of 92% and a sensitivity of 88%⁸. If the patient complains of symptoms when getting out of bed and rolling over in bed, the patient is 4.3 times more likely to have BPPV⁹. Key activities that evoke symptoms are when the patient looks up, gets out of bed, moves the head quickly, rolls over in bed and bends forward⁹. If the patient complains of symptoms when bending the head forward to read or reports sleeping in the prone position, AC-BPPV is suspected.

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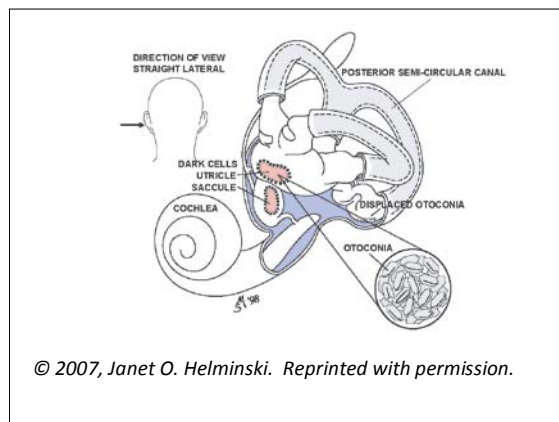


Figure 1.
Left inner ear

TOP 10 REASONS WHY A PHYSICAL THERAPIST SHOULD MANAGE BPPV

Anne K. Galgon, PT, PhD, NCS
Vestibular SIG Vice Chair

Here are my TOP TEN REASONS

- 1) Physical therapists can evaluate and treat gait and balance deficits that are concurrent or result from BPPV.
- 2) Physical Therapists will address functional changes in bed mobility, transfers and ambulation that are concurrent or result from BPPV
- 3) Physical Therapists spend more time with each patient than most other health professionals.
- 4) Physical Therapists will schedule a patient quickly and at a frequency which addresses an individual's BPPV in a timely fashion.
- 5) Physical Therapists can address residual movement sensitivity that may present after nystagmus is resolved.
- 6) Physical Therapists can provide the most appropriate education (knowledge of the disorder, recognizing signs and symptoms, treatment options, self management).
- 7) The physical therapists' optimal goal is self management of the condition.
- 8) Physical Therapists develop rapport with their patient that will help reduce anxiety and intensity of symptoms associated with BPPV during examination and intervention.
- 9) Physical Therapists have the knowledge and skills to examine for BPPV, make appropriate diagnosis and clinical decisions for intervention.
- 10) Physical Therapists have the knowledge and skill to consider other physical, emotional and medical conditions when examining and treating individual patients with BPPV.

Let us know what you think! Tweet you opinion, post your comments and like it on Facebook!



Message from the Chair

By Susan Whitney (Continued from page 1)

Children (usually with associated migraine) to older adults can develop BPPV, with the incidence of BPPV increasing with increasing age.^{6,7} As the US population “greys”, the incidence of BPPV will most likely increase. Patient education and proper management of BPPV is key to the patients’ recovery, especially in older adults. There is now compelling evidence that reports of falls and dizziness are related.⁸ Fear of falling and the return of “normal balance” for the patient with BPPV is a key element that must be addressed after the BPPV has resolved.⁹⁻¹⁶ People who have experienced BPPV deserve quality patient education in order to minimize their fear of recurrence plus fear of falling in order to improve their quality of life.

The goal of this newsletter is to provide an update on some of the newest interventions and data that apply to BPPV. We hope that some of this evidence will influence your practice and improve the care that your patients receive.

Susan L. Whitney, Vestibular SIG Chair

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Practice Guidelines for BPPV

By Heather Dillon (Continued from page 2)

quality as Grade C due to the lack of randomized controlled trials. This recommendation was accompanied by the same patient exclusions as described for the Dix-Hallpike test, which were previously described in this article.

Due to the orientation of the posterior canal in relation to the horizontal canals, the CRP maneuver described for treating posterior canal BPPV is ineffective for treating horizontal canal BPPV. The roll maneuver (Lempert maneuver or barbecue roll) is the most frequently described treatment for horizontal canal BPPV. This maneuver involves rolling the patient 360 degrees with 90 degrees of movement at a time to eliminate the otoconia from the horizontal canal. The only research identified by both groups that examined the effectiveness of this maneuver were Class IV studies which showed success rates ranging from 50% to close to 100%. However due to the lack of higher-level evidence, both groups commented that this treatment was likely effective but were unable to recommend it. The AAN also

commented on additional treatments used to treat horizontal BPPV including forced prolonged positioning, the Gufoni maneuver, the Vannucchi-Asprella liberatory maneuver, as well as maneuvers described by Casani et al. and Appiani et al. Level IV research has described many of these techniques to be effective. However due to the lack of higher level research behind them, official practice recommendations were not made for these techniques. Similarly, the AAN did mention treating anterior canal BPPV but again, the amount and quality of evidence identified was insufficient to warrant any recommendations.

Following treatment of BPPV in any canal, many clinicians provide patients with post-maneuver guidelines that include activity restrictions. These instructions range from wearing a cervical collar to sleeping positions and typically vary between

Practice Guidelines (cont.)

practices. Both the AAN and AAO-HNS examined the necessity of post-maneuver instructions following treatment of BPPV. The research reviewed by the AAN discussed one Class I study and two Class II studies that demonstrated positive outcomes using the CRP as a treatment without using any post-treatment instructions or restrictions. However these studies were not designed to evaluate the use of post-treatment instructions and/or restrictions. Five out of six Class IV studies that were designed to examine these factors showed no added benefit from post-treatment activity restriction or positions. The sixth showed minimal benefit in the use of these restrictions as demonstrated by a reduction in the number of Dix-Hallpike maneuvers needed to produce a negative result as compared to the control. The AAO-HNS guidelines reported similar findings and concluded that there is “insufficient evidence to recommend post-maneuver restrictions in patients treated with CRP (Bhattacharyya et al, 2008).

Another practice that varies following treatment of BPPV is the provision of self-treatment guidelines. Reasons cited for providing the self-treatment instructions include the relatively high recurrence rate of BPPV and to improve efficacy of the treatment provided in the clinic. Those who caution against the use of self treatment maneuvers describe the practice as detrimental to those cured with one maneuver in the clinic because the positions in the self-treatment may cause a recurrence. The AAO-HNS guidelines describe three studies that examined the use of self-treatment maneuvers for the treatment of posterior canal BPPV.

One study found slightly greater improvements in persons provided with self-administered CRP instructions following CRP treatment in the clinic. Another study found self-administered CRP to be more effective than Brandt Daroff exercises (64% improvement compared to 23% respectively). Finally, a third study found the use of a self-CRP more effective than using a modified Semont maneuver (95% resolution compared to 58% respectively) (Bhattacharyya et al, 2008). The guidelines from the AAO-HNS conclude, “in motivated individuals, self-treatment of BPPV may be an option” (Bhattacharyya et al, 2008).

The AAN guidelines described similar findings and also cited studies that concluded that the most effective self treatment for posterior canal BPPV is the self CRP. However, due to the limited research found the AAN concluded “there is insufficient evidence to recommend or refute using Semont maneuver or CRP for BPPV” (Fife et al, 2008).

The use of medication in conjunction with other treatments to manage BPPV has also been the subject of debate when treating persons with BPPV. The types of medications commonly prescribed for BPPV include benzodiazepines (i.e. diazepam, and clonazepam) and antihistamines (i.e. meclizine and diphenhydramine). Benzodiazepines can reduce the subjective sensation of spinning but they may also interfere with vestibular compensation. Antihistamines are used because of their ability to suppress the central emetic center, which can reduce the nausea and emesis than can be experienced with BPPV (Bhattacharyya et al, 2008). The AAN concluded that there was “no evidence to support a recommendation of any medication in the routine treatment for BPPV” (Fife et al, 2008). The conclusion described by the AAO-HNS also lacked support of the use of medication to treat BPPV and described potential harmful effects of using medication due their potential side effects and ability to dampen the response of the vestibular system which may decrease diagnostic sensitivity during BPPV testing. For these reasons, the AAO-HNS recommended against (Grade C) using medications to treat BPPV. The only exception described was when used in conjunction with the recommended treatments for BPPV on a short-term basis to control symptoms such as nausea and vomiting in a person experiencing these symptoms so intensely that the standard treatment may not be possible without them (Bhattacharyya et al, 2008).



Practice Guidelines (cont.)

Additional BPPV practice guidelines that the AAO-HNS recommend include:

- Assessing persons with BPPV for other causes of imbalance, vertigo and dizziness as well as additional modifiable factors that may influence treatment parameters such as co-morbidities, fall risk and anxiety.
- Abstaining from obtaining radiographic imaging, and vestibular testing in persons diagnosed with BPPV who do not have other findings.
- Evaluating persons thought to have BPPV who do not respond to treatments for peripheral vestibular or CNS involvement.
- Educating persons with BPPV on the impact of this condition on safety, potential for recurrence and importance of follow-up.
- Offering vestibular rehabilitation, either through self-treatment, or with a skilled clinician for the treatment of BPPV.
- Reassessing persons with BPPV one month after initial treatment to confirm symptom resolution or provide additional treatment and/or referral.

The guidelines described above were supported by either Grade B or Grade C research. In addition to these recommendations, the use of audiometric testing was also examined in the AAO-HNS guidelines. On study described, conducted by Stewart et al, (1999) found that the audiogram was the most cost-effective test for vertigo as compared to electronystagmography, posturography, MRI and blood tests. However, because traditional BPPV does not involve hearing loss and because waiting for audiometry may delay treatment for BPPV, no recommendation was made for audiometric testing (Grade D).

In summary, both the AAN and AAO-HNS have conducted extensive reviews of the literature to recommend practice guidelines for treating persons with BPPV. Although some practice guidelines had enough evidence to be either recommended or not, some common practices continue to lack enough quality evidence to conclusively be described as beneficial or not for this patient population. Continued research and collaboration between disciplines treating persons with BPPV will add to this body of knowledge and further define patient practice guidelines. This practice will more enable more efficient and efficacious care for persons with BPPV.

Evidence Quality Key

Grade	Evidence quality
A	Well-designed randomized controlled trials or diagnostic studies performed on a population similar to target population.
B	Randomized controlled trials or diagnostic studies with minor limitations; observational studies present that provide consistent evidence
C	Observational studies only (case-control and cohort design)
D	Expert opinion, case reports, reasoning from first principles (bench research/animal studies)
X	Situations when validating studies unable to be performed due to clear preponderance of benefit over harm

Table adopted from: Bhattacharyya et al. 2008: p S5

Clinical Practice Guidelines for BPPV— Reference List

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Horizontal Canal BPPV-- other signs and tests

By Anne Galgon (continued from page 4)

involvement and results in more intense nystagmus. As a result, the intensity of the nystagmus and symptoms is the diagnostic criteria for side of localization in the SRT^{6,11,12}. Rates of undetermined side of involvement with the SRT have been reported between 11.5 % and 16% in individuals with HC BPPV^{2,3,14}. In most of these studies, the intensity of the nystagmus is recorded using infrared camera systems to measure the eye movement velocities of the nystagmus. Determining differences in intensity may be more difficult in physical therapy practices without this specific equipment.

Summary of other signs and positional tests

Other signs and positional tests that can be utilize when the side of involvement is undetermined with the SRT, include a sitting spontaneous nystagmus, the Head Pitch Test or Bow and Lean Test, the Supine to Sit Test and the Head Shake Test. **Spontaneous nystagmus** (or pseudo spontaneous nystagmus) in individuals with HC BPPV was first described by Bisdorff and Debatisse in 2001⁸. Since that time others have reported spontaneous nystagmus in upright sitting in 64-76% of individuals with HC BPPV^{9,13,15}. Spontaneous nystagmus is a unique finding to HC BPPV and is not seen in any other forms of BPPV⁹. The nystagmus is explained in HC BPPV due to the ~30 degree up pitch of the HCs in relationship to the upright head and the potential gravitational influence on the otoconia in the HC. By pitching the head up an additional 30 degrees the nystagmus intensifies and by pitching the head down 60 degrees, the nystagmus will change directions. There should also be a “null point” where the nystagmus will go away, this occurs when the head is pitch down approximately 30 degrees and the HCs are perpendicular to the gravitational vector⁸. In a clinical exam changing the head position to provoke a change in nystagmus will be important to distinguish these signs from spontaneous nystagmus associated with an acute vestibular sensory imbalance such as a unilateral peripheral hypofunction.

The up pitch and down pitch head positions together, the **Head Pitch Test (HPT)**¹³ or **Bow and Lean Test (BLT)**¹⁴, may further differentiate between sides of involvement. The upward pitch (or lean) creates a horizontal nystagmus away from the side of involvement in the geotropic form and toward the side of involvement in the apogeotropic form. The downward pitch (Bow) creates a horizontal

nystagmus towards the side of involvement in the geotropic and away from the side of involvement in the apogeotropic form^{2,3,9,12,13-14}. Positive findings on the BLT (or HPT) have been reported in 72%³ and 76.8%² in individuals with HC BPPV. These authors reported that adding these positional tests increase the ability to localize side of involvement and increased the success rate of the canalith repositioning maneuver (CRM) intervention^{2,3,14}. Lee and colleagues² compared success rates after first CRM in individuals diagnosed with the SRT alone or with the SRT and the BLT together. The success rate increased from 67.4%, (SRT alone) to 83.1% with BLT added in individuals with geotropic form, and increased from 61.1% to 74.7% in the apogeotropic form. When there is a discord between the interpretation of side of involvement in the SRT and the BLT, they argued that the BLT localized the side of involvement better, because the CRM reduced nystagmus more effectively when the direction of the CRM (Log Roll maneuver) was determined by the BLT.^{2,14} The BLT may not assist as well in identifying side in the apogeotropic form, as one study¹ only reported positive findings on this test in 24% of a group of 64 individuals with apogeotropic HC BPPV.

Moving the patient from long sitting to supine and observing for nystagmus, the **Sit to Supine Test (SST)**, is another option to identify side of involvement^{4,13,15}. The SST reproduces the same effect on the HCs as the up pitch or lean component of the BLT, but moves the head through a greater excursion resulting in a more likely provocation of a positional nystagmus following the same directional rules of the upward pitch of the head. (In supine: horizontal nystagmus beats away from the side of involvement in the geotropic form and toward the side of the involvement in the apogeotropic form.) Asprella-Libonati^{13,15} and Han et al⁴ both independently recommended this test as the best method to identify side of involvement when a difference in intensity could not be distinguished with the SRT. A positive horizontal nystagmus on the SST has been reported in between 75%¹ and 96%¹³ of patients with HC BPPV. Asprella-Libonata^{13,15} developed clinical recommendations for identifying side of involvement using combination of SRT, spontaneous nystagmus, and the SST together. For the geotropic form of HC BPPV the involved side will be:

1) the side on which the nystagmus is most intense during the SRT, and/or 2) the side opposite the direction of the spontaneous nystagmus in sitting, and/or 3) the side opposite the direction of the nystagmus for the SST. For the apogeotropic form the involved side will be; 1) the side on which the nystagmus is less intense during the SRT, and/or 2) the side which the spontaneous nystagmus beats in sitting, and/or 3) side which the nystagmus beats during the SST.

Head Shaking Induced Nystagmus (HSIN) may be an additional sign to localize side. The **Head Shake Test** involves rotating the head in upright several times at ~2Hz and then observing for nystagmus¹. In both the geotropic and apogeotropic forms HSIN will beat toward the healthy side (or away from the involved side)¹. Califano and colleagues¹ found a positive nystagmus with fast phase beating away from the side of involvement in 40 out of 64 (62.5%) of patients with the apogeotropic form of HC BPPV. HSIN after the head shake test with HC BPPV has not been consistently described elsewhere in the literature. Asprella-Libonati¹³ described slow head rotations may evoke a spontaneous horizontal nystagmus in some individuals who did not show an initial spontaneous nystagmus. De Stefano and colleagues⁹ reported that individuals with spontaneous nystagmus associated with HC BPPV had negative head shaking tests. The head shake test may also convert apogeotropic to a geotropic form in some cases¹.

Clinical considerations:

There does not appear to be one method that will identify side of involvement in all patients with HC BPPV. Clinicians may be more successful identifying side, if they are familiar and able to utilize all of the tests described above. By adding the BLT (or HPT) to Asprella-Libonata's recommendations¹³ for side identification, the clinician has more flexibility in making an accurate diagnosis and can utilize these tests as needed to accommodate individual patient factors and presentations. Table 2 presents the rules for interpreting side of involvement based on the three additional findings/positional tests discussed above once the horizontal canal and form of BPPV have been identified with the SRT. Interpreting HSIN was not included in the table, because consistent interpretations have not been reported in the literature. The other tests have stronger validity because they have been described and utilized by several independent clinical research groups. In this work the guidelines for interpretation are consistently described

and not difficult to follow.

In addition, these tests should not take much time in the examination. Each test should only take about 1 minute to perform. A likely order to perform the test would be to 1) observe for spontaneous nystagmus and 2) perform the BLT in upright sitting, 3) then move the patient into supine with the SST and 4) then perform the SRT last. The biggest consideration is how many provocative tests a patient can tolerate during an examination period. Will performing the entire battery make the patient so uncomfortable that they will not complete the exam or allow an intervention to be applied in a single session? Some researchers have discussed this issue and developed strategies to identify side of involvement with the least amount of provocation of symptoms. Asprella-Libonata,^{13,15} Han et al⁴ and Califano et al¹ have independently recommended performing SST together to the SRT, since the patient would have to go into supine position before the SRT. The results of these two tests will give side of involvement in a high proportion of patients. Asprella-Libonata,^{13,15} and Califano et al¹ also suggest checking for spontaneous nystagmus prior to any maneuvers to add an additional piece of information without over stimulating the individuals (See Asprella-Libonata recommendations above). Califano and colleagues had examined the results of all the signs and positional test reviewed here, in several individuals with HC BPPV, and felt the largest number of patients would only require spontaneous nystagmus, SST and SRT to determine side of involvement. Only in the "rare" conditions, when a side of involvement could not be determined, would they recommend returning patient to sitting and perform BLT and the Head Shake test¹. Alternatively, Lee and colleagues² found they could diagnosis side of involvement in 100% of patients with the BLT and the SRT alone.

For best results these tests should be performed in physical therapy setting with video goggles or Frenzel lenses, where fixation is removed and eye movements can more clearly be observed. In the research reviewed here all the signs and positional tests used infrared video systems to identify and measure nystagmus. The literature has not demonstrated how well the horizontal nystagmus in HC BPPV is observed with or without goggle systems that cannot measure nystagmus. However, horizontal nystagmus in SST can be seen in many individuals without goggles (based on personal experience).

Conclusions:

Identifying side of involvement in HC BPPV is an essential diagnostic component to assist in selecting appropriate CRM interventions. This article reviewed four additional signs and positional tests that may help physical therapists identify side of involvement when combined with the SRT. The consistency at which spontaneous nystagmus, the BLT, SST has been described by different clinical research groups warrants adoption of these tests in to physical therapists' repertoire. Therapist should be encouraged to keep reading this literature, which provides very good depictions of the methods for implementing the tests and the underlying otoconia influences on the system and how they related to the presentation of nystagmus during the testing positions. Although the best combination of tests for the least amount of provocation has not been fully established, physical therapists should enhance their knowledge and skill in applying these tests to increase their diagnostic capability. Therapists should have the flexibility to add these tests as needed to accommodate different patient presentations of HC BPPV.

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Table 1. Differential diagnosis of semicircular canal (SCC) involvement, type of BPPV, and side of involvement based on direction, duration and intensity of nystagmus

Positional test	SCC Involvement	Direction of nystagmus	Type of BPPV	Side of Involvement
Dix-Hallpike Test	Posterior SCC	Up-beating torsional to side of head rotation	<i>Canalithiasis</i> < 1 minute	Side of head rotation when nystagmus is provoked
	Anterior SCC	Down-beating torsional to side of head rotation	<i>Cupulolithiasis</i> > 1 minute	
Supine Roll Test	Horizontal SCC	Horizontal nystagmus (duration not significant) Geotropic nystagmus (toward the ground) → <i>Canalithiasis</i> → Side of more intense Apogeotropic Nystagmus (away from the ground) → <i>Cupulolithiasis</i> → Side of less intense		

Table 2. Additional test to determine side of involvement in horizontal SCC BPPV

Form of HC BPPV	Positional test	Direction of horizontal nystagmus
Geotropic (<i>Canalithiasis</i>)	Spontaneous (pseudo) nystagmus	Away from side of involvement
	Bow and Lean (or Pitch) Test <i>Up pitch (Lean)</i> <i>Down pitch (Bow)</i>	Away from side of involvement Toward the side of involvement
	Sit to Supine Test	Away for side of involvement
Apogeotropic (<i>Cupulolithiasis</i>)	Spontaneous (pseudo) nystagmus	Toward the side of involvement
	Bow and Lean (or Pitch) Test <i>Up pitch (Lean)</i> <i>Down pitch (Bow)</i>	Toward the side of involvement Away from the side of involvement
	Sit to Supine Test	Toward the side of involvement

Stop the World-I want to get off

By Michael Shubert (continued from page 5)

This principal becomes critical for diagnosing hSCC- BPPV as the otoconia can be thought of moving towards or away from the utricle/cupula, with a resultant nystagmus. Additionally critical is to know that the cupulae of the hSCC are anteriorly positioned in the head. If you were to make a fist with each hand and hold your arms in front of you in a flat horizontal circle, your fists would represent the cupula from each hSCC.

If the otoconia are freely floating in the middle or posterior arms of the hSCC, the resulting nystagmus will be short-lived (generally less than 60 seconds) and will beat towards the earth regardless of head direction (geotropic), when in a side lying position. When the otoconia move towards the cupula, the nystagmus will be of greater velocity than the nystagmus generated from the otoconia moving away from the utricle (due to the excitation-inhibition asymmetry). Therefore, free floating otoconia in the left horizontal canal will generate a left beating nystagmus in left side lying of greater velocity than the right beating nystagmus in right side lying (**Figure 2A**). Therefore the rule for lateralizing the affected hSCC when geotropic nystagmus is identified is that the nystagmus will beat greater towards the affected ear (in the above example, the faster left beat nystagmus identifies the left hSCC as being affected).

If the otoconia are adherent to the cupula of the hSCC the resulting nystagmus will be apogeotropic and typically persist beyond 1 minute. It will beat away from the earth regardless of head direction, when in a side lying position. In cupulolithiasis, the otoconia weigh down the cupula, and cause the hSCC cupula to deflect towards or away from the utricle when the head is supine and then rolled to the right or left. Thus, otoconia stuck to the cupula of the left hSCC will deflect the cupula towards the utricle (and therefore excite the afferents) when the head is rolled to the right (**Figure 2B**). In contrast, the left cupula would be deflected away from the utricle when rolled to the left (and inhibit the left vestibular afferents). Therefore, the nystagmus in right roll will be of greater velocity than the nystagmus in left roll – again due to the excitation-inhibition asymmetry. Therefore the rule for lateralizing the affected hSCC when apogeotropic nystagmus is identified is that the nystagmus will be slower (or beat less) when lying on the affected ear. It is possible to have an apogeotropic nystagmus that is less than 1 minute in duration due to freely floating otoconia in the anterior arm of the hSCC (**Figure 2C**).

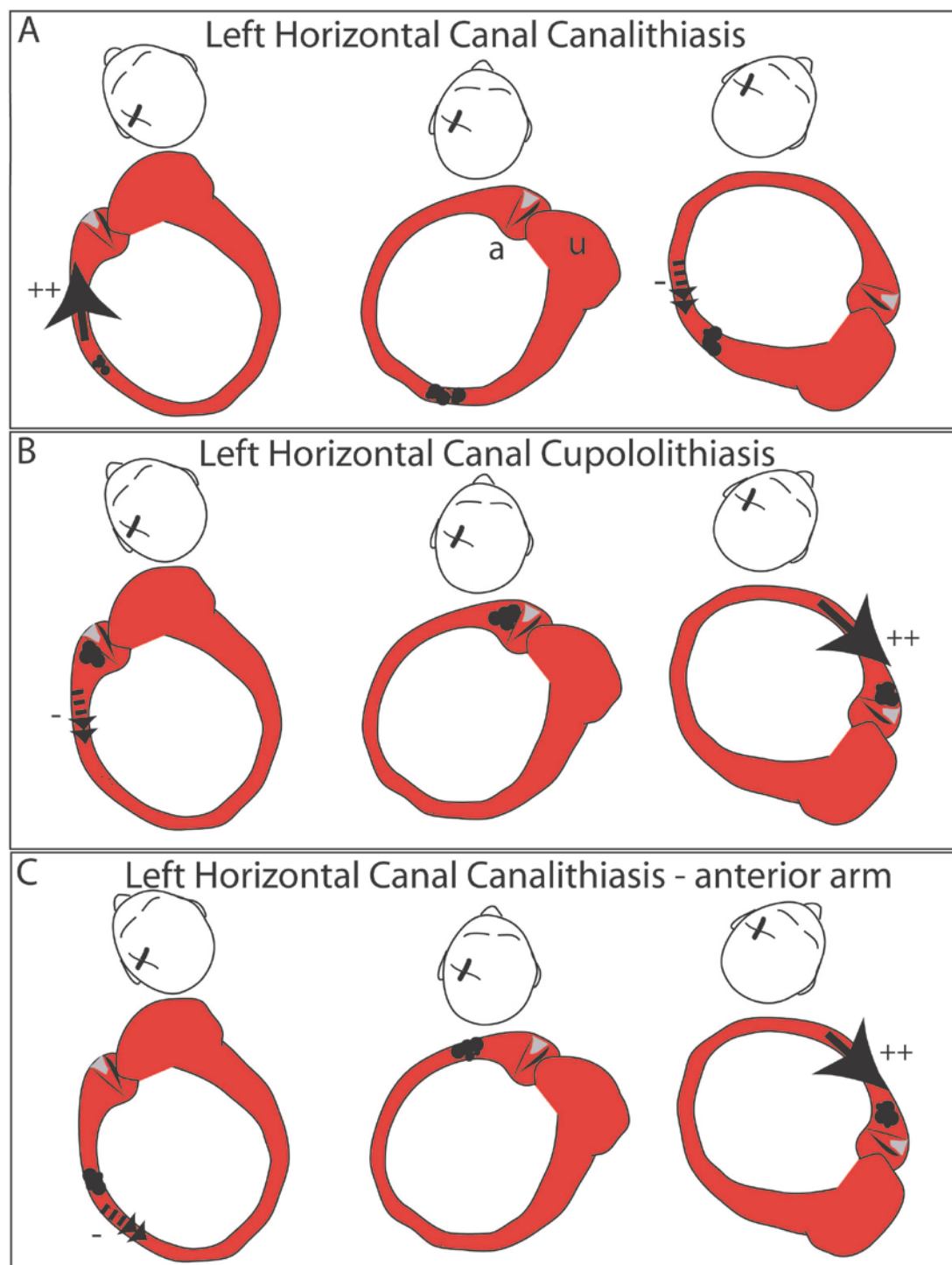
In review, the duration and direction of the horizontal nystagmus are critical for diagnosis and enable the clinician data to determine the affected ear.

Unfortunately, in the case of persistent cupulolithiasis, what can't be known is whether the otoconia are adherent to utricular or canal side of the cupula.....but that discussion is for another newsletter. Wondering about Ewalds 1st law? - The eyes move along the same axis as that of the stimulated semicircular canal.

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Figure 2. Horizontal Semicircular Canal BPPV



The left hSCC is shown with otoconia. Large full arrows with positive symbol denotes excitation while the smaller and stippled arrows with negative symbol denotes inhibition. a = ampulla; u = utricle.

Differential Diagnosis and Treatment of Anterior Canal BPPV

By Janet Odry Helminski (continued from page 6)

Positional Testing to Diagnosis BPPV

The Dix-Hallpike Test (DHT) is the standard clinical positional test for evaluating the vertical canals^{7,10}. PC-BPPV is identified with the DHT with an estimated sensitivity of 79% (95% CI 65-94) and specificity of 75% (95% CI 33-100)¹¹. Positional testing is best performed with an examination tool that prevents visual fixation such as Frenzel goggles or video-oculography. Visual fixation suppresses ocular nystagmus. Vestibular suppressant medication that suppresses ocular nystagmus should also be avoided, such as Diazepam (valium) or Meclizine (antivert, bonine). If the patient has a history of vomiting, Ondansetron (Zofran) may be administered prior to treatment. Each position of the DHT should be maintained for a minimum of 45 seconds to allow debris to settle within the canal.

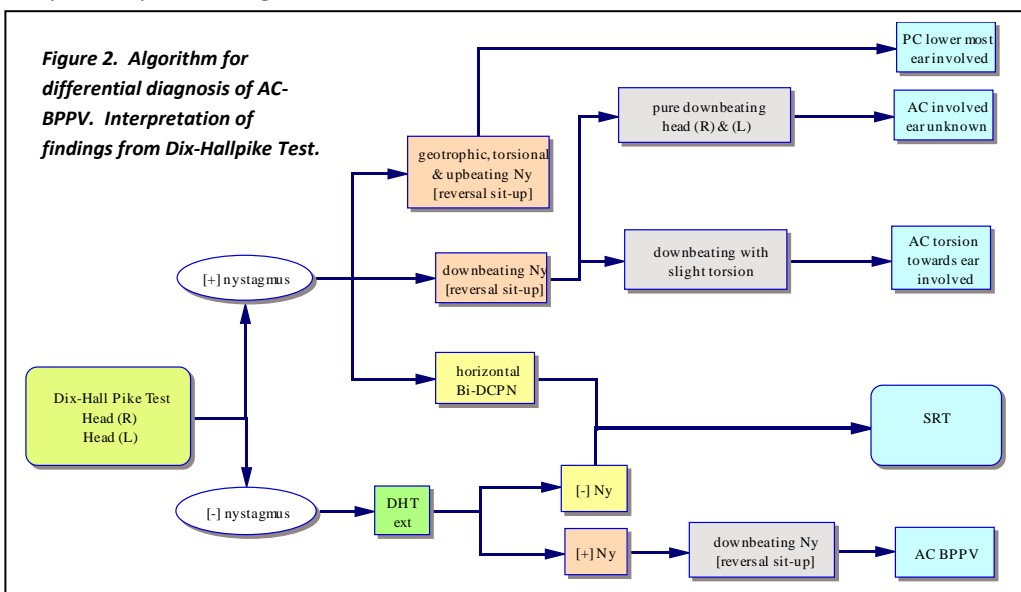
The diagnostic criteria for AC-BPPV is vertigo associated with ocular nystagmus during the DHT. The vector of the ocular nystagmus is primarily downbeating with a small secondary torsional nystagmus directed towards the involved ear or no torsional nystagmus (50% of patients)⁴. The characteristics of the nystagmus include 1-5 second latency before the onset of nystagmus, nystagmus < 60 seconds in duration, and fatigues with repeated positioning⁴.

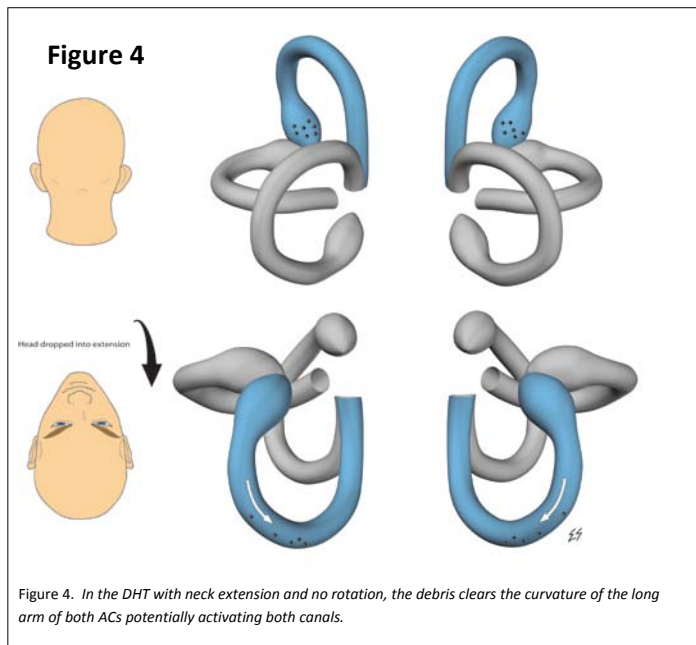
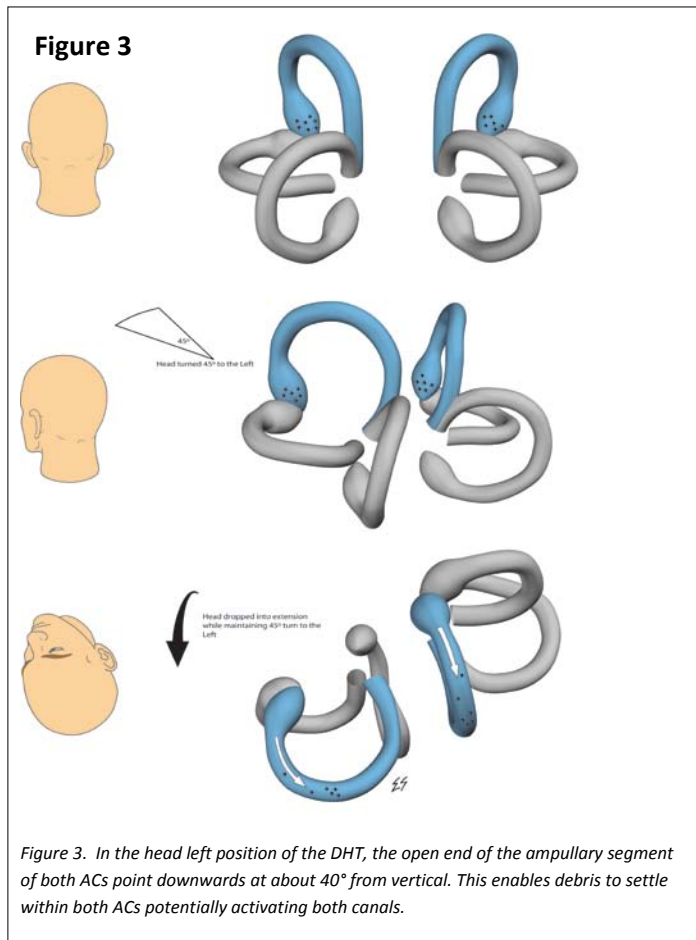
With AC-BPPV, findings on the DHT are difficult to interpret (Figure 2). In both the head right and head left positions of the DHT, the open end of the ampullary segment points downwards at about 40° from vertical⁴. Thus a positive downbeating nystagmus may be evoked in both the head right and head left position (Figure 3). If present, the direction of the small torsional vector of the nystagmus will be towards the involved ear⁴. For example, if the left AC is involved, in the head left position, the secondary torsional vector will be towards the left lowermost ear (geotropic) while in the head right position, the secondary torsional vector will be towards the left uppermost ear (apogeotropic). However, in 50% of cases, only downbeating nystagmus is observed in the dependent test positions making it impossible to identify the ear involved⁴.

The DHT may produce a false negative in the head right and left position because the debris within the canal can't clear the long arm due to the orientation of the ampullary segment. If the patient's history suggests BPPV and the DHT is negative, the patient should be brought back into the recumbent position with the cervical spine in 30° of extension without cervical rotation⁴. Lack of rotation adds an additional 20° of

extension to the resultant position of the head. This enables the otoconia to clear the curvature of the long arm (Figure 4). Authors have suggested a minimum of 60° of cervical extension is needed to clear the curvature¹². The ability to position the patients into 60° of extension may be limited by both cervical and thoracic spinal dysfunction.

Caution should be used with interpretation of findings on positional testing. In patients





with positional downbeating nystagmus and no primary gaze downbeating nystagmus, 75% of 50 consecutive patients had evidence of CNS dysfunction suggesting CNS dysfunction as the probable cause of positional downbeating nystagmus and 25% had idiopathic positional downbeating nystagmus⁴. Therefore the differential diagnosis needs to be made based on history, and findings on neurologic examination and positional testing.

Particle Repositioning Maneuvers for Treatment of AC- BPPV

Neck Extension – Side Involved Unknown

If the bilateral DHT and/or the straight head hanging position evoke pure downbeating nystagmus with no torsional component, AC-BPPV may be suspected but the side involved is unknown. If the involved ear is unknown, cervical extension over the edge of the table in the

recumbent position should enable otoconia to clear the curvature of both ACs¹³. A minimum of 60° of cervical extension is needed¹². To perform the maneuver, the patient sits on the examination table (Figure 5)¹³. The patient is brought into the recumbent position with the head extended over the edge of the table. The position is held for 2 minutes to provide adequate time for the debris to settle in the AC. The patient is returned to the upright position. This maneuver is repeated 3 times.

360° Forward Rotation – Side Involved Identified

If the bilateral DHT evokes pure downbeating nystagmus with a small torsional component, the direction of the torsion vector will be towards the involved ear⁴. Once the involved ear is identified, a 360° forward rotation around the AC clears the debris from the canal into the vestibule (Figure 6)¹⁴. During the maneuver, the therapist supports the patient’s head. Caution must be taken to ensure that the neck is kept in alignment and not strained and that the patient does not have spinal dysfunction that would limit the patient’s ability to participate in the

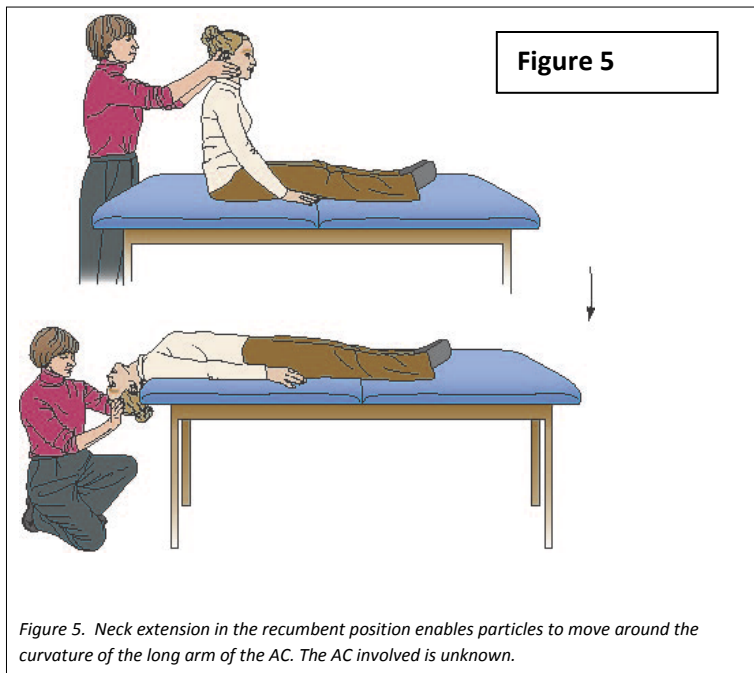


Figure 5

maneuver. If the left AC is involved, the patient lies prone on elbows on the edge of the mat¹⁴. The head is turned 45° towards the right. The head is brought forward over the edge of the mat and held for a minimum of 30 seconds. The head is then turned 90° towards the left into 45° of rotation towards the left. The position is held for a minimum of 30 seconds. The patient rolls towards the left onto the back into the right head left position of the DHT. The position is held for 30 seconds. The patient sits up. Three cycles are performed.

If the patient cannot tolerate neck extension or a 360° forward roll, maneuvers designed to treat the PC may be modified for the AC. These maneuvers do not take into account the orientation of the ampullary segment which may result in difficulty clearing the AC. To accommodate the AC plane, rotation of the head is modified during the liberatory maneuver (Figure 7)¹⁵.

Figure 5. Neck extension in the recumbent position enables particles to move around the curvature of the long arm of the AC. The AC involved is unknown.

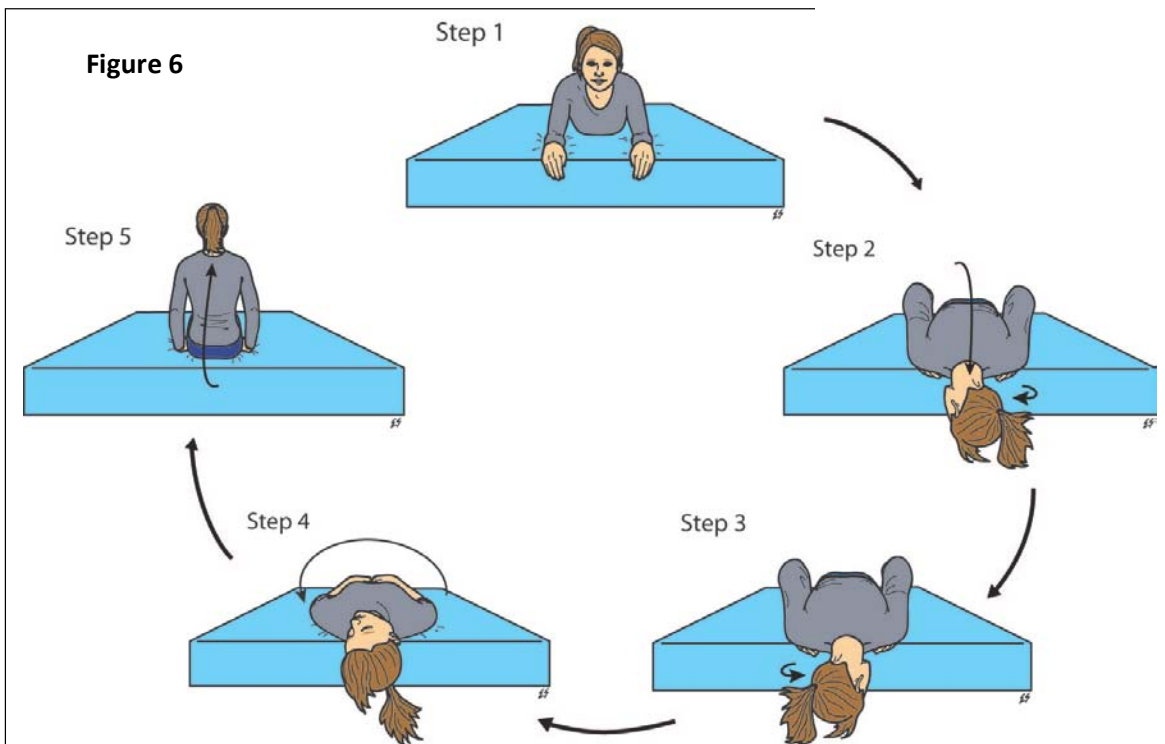


Figure 6

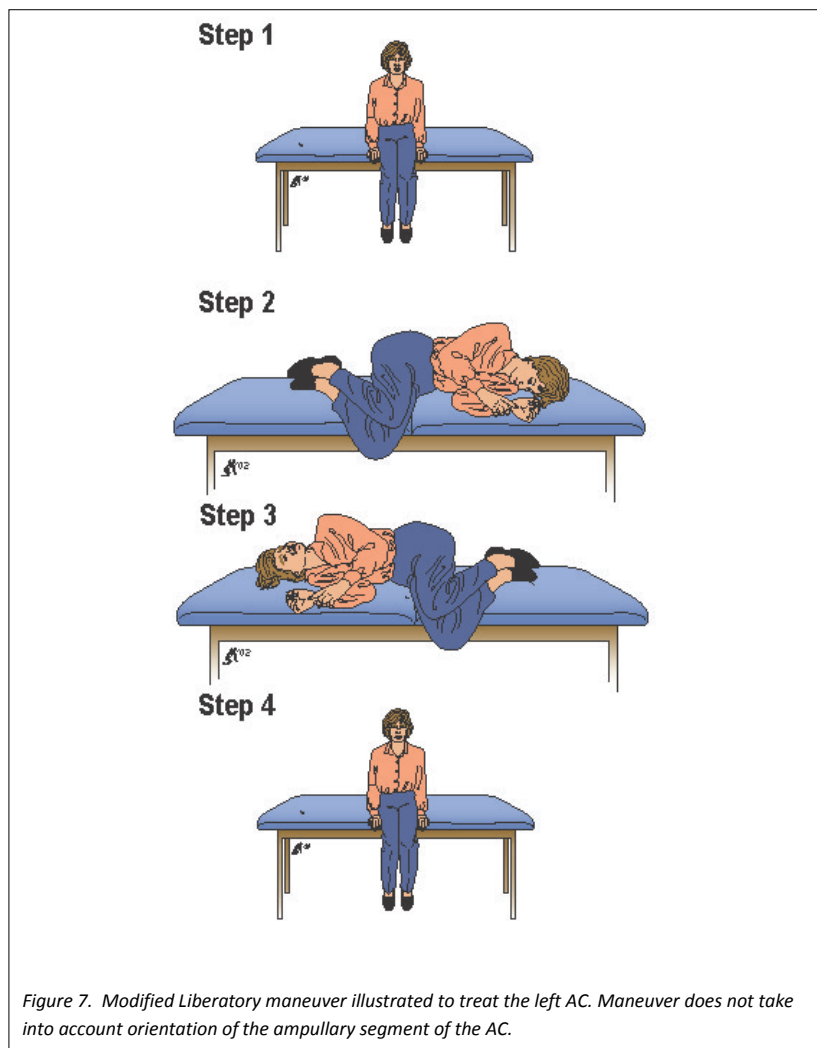
Figure 6. Forward 360° rotation illustrated to treat the left AC. The therapist supporting the head is not illustrated.

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Initially, when the patient is positioned on the involved side, the head is rotated 45° towards the floor. When the patient is flipped onto the uninvolved side, the head is rotated 45° towards the ceiling.

Conclusion

The radii of curvature of the AC creates challenges in differential diagnosis and treatment of AC-BPPV. In the recumbent positions of the DHT a primarily downbeating nystagmus is evoked^{4,5}. No torsional component will be present in 50% of cases⁴. A small torsion directed towards the involved ear may be observed⁴. If a negative bilateral DHT is found but



history suggests BPPV, the clinician should evaluate the patient in the straight head hanging position to enable particles to move around the curvature of the long arm of the AC⁴. Particle repositioning maneuvers include 60° of neck extension¹³ in the recumbent position if side involved unknown and a forward 360° roll¹⁴ if the side is known. Caution must be taken to screen the spine and vertebral artery prior to evaluation and treatment to avoid injury.

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CSM 2013: Date & Location Change

CSM 2013 event will not be held in February in Nashville as originally planned. Instead, CSM 2013 will take place January 21-24 in San Diego, California.

<http://www.apta.org/csm/>

PT 2013 June 26-29, 2013 – Salt Lake City, Utah

CSM 2014 February 3-6, 2014 – Las Vegas, Nevada

CSM 2015 February 4-7, 2015 – Indianapolis, Indiana

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