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Benign Paroxysmal Positional Vertigo (BPPV)

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Benign paroxysmal positional vertigo (BPPV) is the most common disorder of the inner ear's vestibular system, which is a vital part of maintaining balance. BPPV is *benign*, meaning that it is not life-threatening nor generally progressive. BPPV produces a sensation of spinning called *vertigo* that is both *paroxysmal* and *positional*, meaning it occurs suddenly and with a change in head position.

Why does BPPV cause vertigo?

The vestibular organs in each ear include the utricle, saccule, and three semicircular canals. The semicircular canals detect rotational movement. They are located at right angles to each other and are filled with a fluid called endolymph. When the head rotates, endolymphatic fluid lags behind because of inertia and exerts pressure against the *cupula*, the sensory receptor at the base of the canal. The receptor then sends impulses to the brain about the head's movement.

BPPV occurs as a result of *otoconia*, tiny crystals of calcium carbonate that are a normal part of the inner ear's anatomy, detaching from the otolithic membrane in the utricle and collecting in one of the semicircular canals. When the head is still, gravity causes the otoconia to clump and settle (Figure 1). When the head moves, the otoconia shift. This stimulates the cupula to send false signals to the brain, producing vertigo and triggering *nystagmus* (involuntary eye movements).

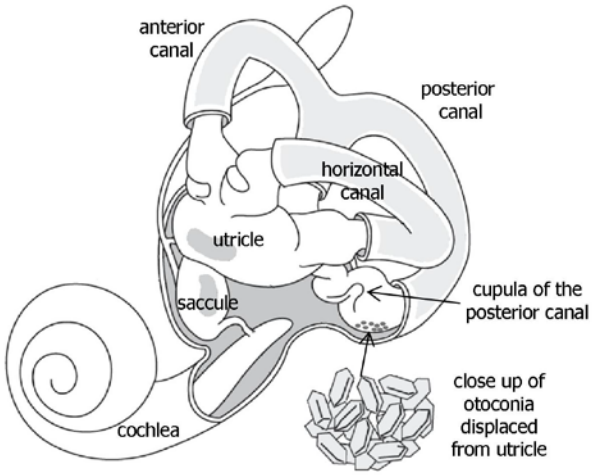

Figure 1: Inner ear anatomy. Otoconia migrate from the utricle, most commonly settling in the posterior semicircular canal (shown), or more rarely in the anterior or horizontal semicircular canals. The detached otoconia shift when the head moves, stimulating the cupula to send false signals to the brain that create a sensation of vertigo.

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Types of BPPV

Subtypes of BPPV are distinguished by the particular semicircular canal involved and whether the detached otoconia are free floating within the affected canal (canalithiasis) or attached to the cupula (cupulothiasis). BPPV is typically unilateral, meaning it occurs either in the right or left ear, although in some cases it is bilateral, meaning both ears are affected. The most common form, accounting for 81% to 90% of all cases, is canalithiasis in the posterior semicircular canal.[1]

Symptoms

In addition to vertigo, symptoms of BPPV include dizziness (light-headedness), imbalance, difficulty concentrating, and nausea. Activities that bring on symptoms can vary in each person, but symptoms are precipitated by changing the head's position with respect to gravity. With the involvement of the posterior semicircular
canal in classic BPPV, common problematic head movements include looking up, or rolling over and getting out of bed.

BPPV may be experienced for a very short duration or it may last a lifetime, with symptoms occurring in an intermittent pattern that varies by duration, frequency, and intensity. It is not considered to be intrinsically life-threatening. However, it can be tremendously disruptive to a person's work and social life, as well as pose a health hazard due to an increased risk of falls associated with dizziness and imbalance.

Causes

BPPV is the most common vestibular disorder; 2.4% of all people will experience it at some point in their lifetimes.[1] BPPV accounts for at least 20% of diagnoses made by physicians who specialize in dizziness and vestibular disorders, and is the cause of approximately 50% of dizziness in older people.[2]

The most common cause of BPPV in people under age 50 is head injury and is presumably a result of concussive force that displaces the otoconia. In people over age 50, BPPV is most commonly idiopathic, meaning it occurs for no known reason, but is generally associated with natural age-related degeneration of the otolithic membrane. BPPV is also associated with migraine[3] and ototoxicity. Viruses affecting the ear (such as those causing vestibular neuritis) and Ménière's disease are significant but unusual causes. Occasionally BPPV follows surgery as a result of the trauma on the inner ear during the procedure combined with a prolonged supine (laying down face-up) position.[4] BPPV may also develop after long periods of inactivity.

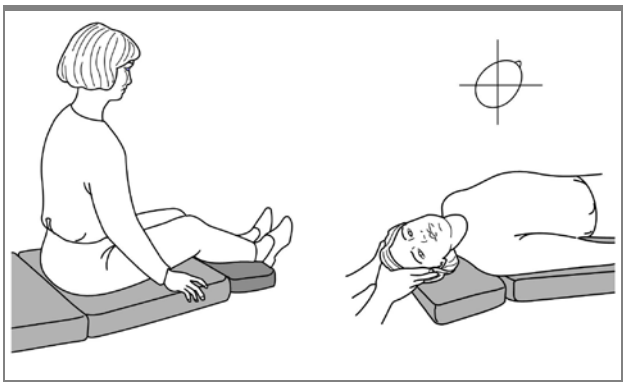


Figure 2a: Canalith repositioning procedure (CRP) for right-sided BPPV. Steps 1 & 2 of CRP are identical to the Dix-Hallpike maneuver used to elicit nystagmus for diagnosis. The patient is moved from a seated supine position; her head is then turned 45 degrees to the right and held for 15-20 seconds.

Diagnosis

BPPV is diagnosed based on medical history, physical examination, the results of vestibular and auditory (hearing) tests, and possibly lab work to rule out other diagnoses. Vestibular tests include the Dix-Hallpike maneuver (see Figure 2a) and the Supine Roll test. These tests allow a physician to observe the nystagmus elicited in response to a change in head position. The problematic semicircular canal can be identified based on the characteristics of the observed nystagmus.

Frenzel goggles, especially of the type using a TV camera, are sometimes used as a diagnostic aid in order to magnify and illuminate nystagmus. If electronystagmography (ENG) is employed to observe nystagmus with position changes, it is important that the equipment used is capable of measuring vertical eye movements. A physician may also order radiographic imaging such as a magnetic resonance imaging scan (MRI) to rule out other problems such as a stroke or brain tumor, but such scans are not helpful in diagnosing BPPV.[5] In addition, a physician may order auditory tests to help pinpoint a specific cause of BPPV, such as Ménière's disease or labyrinthitis.

Treating BPPV with in-office particle repositioning head maneuvers

Recommended treatment for most forms of BPPV employs particle repositioning head maneuvers that move the displaced otoconia out of the affected semicircular canal. These maneuvers involve a specific series of patterned head and trunk movements that can be performed in a health care provider's office in about 15 minutes.

Maneuvers for posterior canal BPPV

Particle repositioning head maneuvers are considered to be more effective than medication or other forms of exercise-based therapy[6] in treating posterior canal BPPV. However, even with successful treatment with such maneuvers, BPPV recurs in about one-third of patients after one year, and in about 50% of all patients treated after five years.[7,8,9]

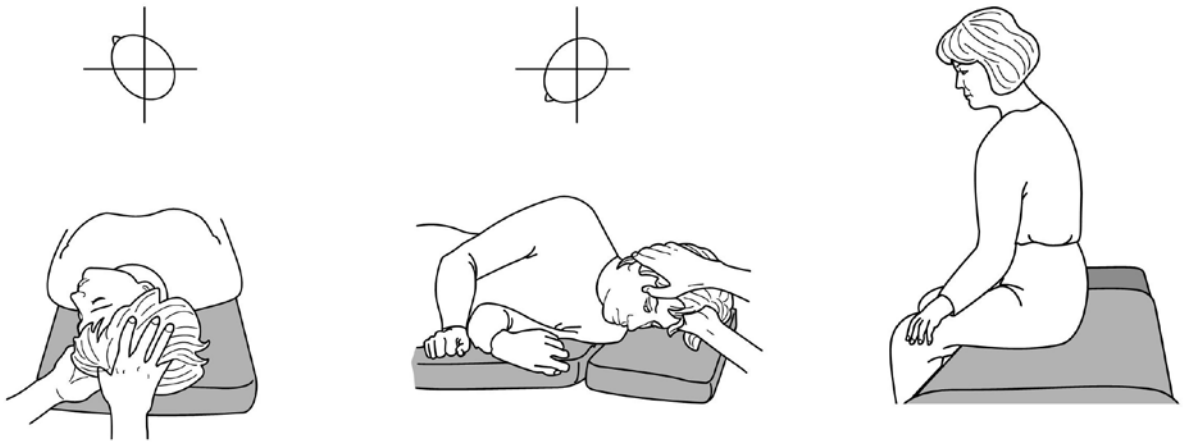
The *canalith repositioning procedure* (CRP) is the most common and

empirically proven treatment for posterior canal BPPV.[1] Also called the Epley maneuver or the modified liberatory maneuver, CRP involves sequential movement of the head into four positions, with positional shifts spaced roughly 30 seconds apart (Figure 2a and 2b). Differing opinions exist about the benefits of using mastoid vibration during CRP,[10] with a recent evidence-based research review suggesting that it probably does not benefit patients.[1]

Occasionally, when CRP is being performed, neurological symptoms (e.g., weakness, numbness, and visual changes other than vertigo) occur, caused by compression of the vertebral arteries.[11] In this case, persisting with the maneuver can lead to stroke. However, medical professionals can modify the exercises or use special equipment so that the positions are attained by moving body and head simultaneously, thereby avoiding the problematic compression.

The *Semont maneuver* involves a procedure whereby the patient is rapidly moved from lying on one side to lying on the other. Although many physicians have reported success treating patients with the Semont maneuver[12] and support its use, more studies are required to determine its effectiveness.[1]

Figure 2b: Canalith repositioning procedure (CRP) for right-sided BPPV (continued). In Step 3 of the CRP, the head is turned 90 degrees until the unaffected left ear is facing the floor. The patient turns her body to follow her head, and the position is held for 15-20 seconds (Step 4); afterwards, she returns to a seated position (Step 5). The mirror image of these maneuvers can be performed for left-sided BPPV.



Maneuvers for horizontal canal BPPV

Because of the relative rarity of horizontal canal BPPV, there are no best practices established for treatment maneuvers; however, the most widely studied is the *Lempert maneuver*.[1] This maneuver entails moving the head through a series of 90° angles and pausing between each turn for 10 to 30 seconds. Other techniques such as the *Gufoni maneuver* and the *Vannucchi-Asprella liberatory maneuver* have also been used to treat horizontal canal BPPV, but additional well-supported clinical studies are needed to assess their effectiveness.[1]

Maneuvers for anterior canal BPPV

There is no definitive treatment for anterior canal BPPV and no controlled studies of it have yet been completed. However, there is a logical modified maneuver for the anterior canal that is essentially a deep (exaggerated) Dix-Hallpike.[13] Other proposed treatments employ reverse versions of the maneuvers used for posterior canal BPPV; for example, the reverse Semont (starting nose down and turned to the unaffected side), or the reverse Epley (again starting nose down). These treatments are geometrically reasonable, but require additional study to prove their efficacy.

Post-treatment considerations

After successful treatment with particle repositioning maneuvers, residual dizziness is often experienced for up to three months. Whether post-treatment activity restrictions are useful has not been adequately studied.[1] Nevertheless, many physicians recommend that their patients sleep in an elevated position with two or more pillows and/or not on the side of the treated ear, wear a cervical collar as a reminder to avoid quick head turns, and avoid exercises that involve looking up or down or head rotation (such as freestyle lap swimming). Such precautions are thought to help reduce the risk that the repositioned debris might return to the sensitive back part of the ear before it either adheres or is reabsorbed.

Other BPPV treatment options

If head maneuvers don't work, other treatment options include home-based exercise therapy, surgery, medication, or simply coping with the symptoms while waiting for them to resolve.

Vestibular rehabilitation home exercises

Exercises performed at home are sometimes recommended. *Brandt-Daroff exercises*
(Figure 3) involve repeating vertigo-inducing movements two to three times per

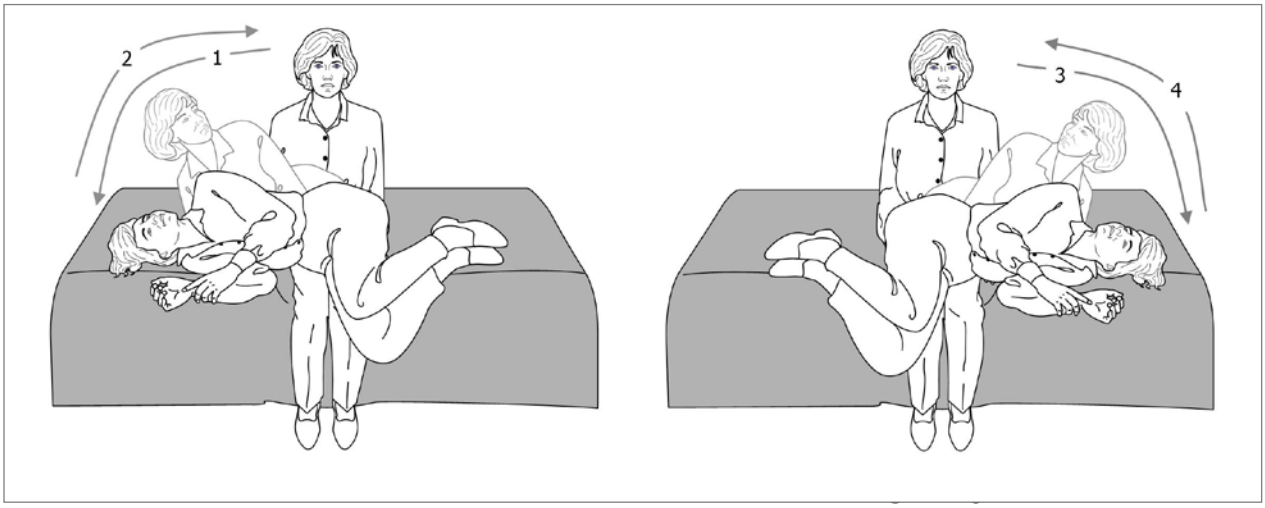
day for up to three weeks. After receiving training from a doctor or physical therapist, a patient can perform the exercises at home, but they are more arduous than office treatments. With adherence to the prescribed schedule, Brandt-Daroff exercises have been reported to reduce vertiginous responses to head movements in 95% of cases.[14] Patients performing Brandt-Daroff exercises may develop multicanal BPPV as a complication and so should note any symptom changes to their physicians.[14]

Another home exercise method is daily self-administration of particle repositioning head maneuvers. One potential problem with this method is that it may cause the condition to worsen or initiate problems in another semicircular canal. Although one study[15] has reported a cure rate as high as 95% for this strategy, insufficient evidence exists to recommend or refute its use.

For horizontal canal BPPV that does not respond to head maneuvers, a home treatment called *forced prolonged positioning* may be recommended. This requires a patient to rest in bed for at least 12 hours with the head turned toward the unaffected ear, permitting the canaliths to gradually move out of the canal.

Finally, some physicians suggest that after office treatment, patients might perform a daily self-canalith repositioning exercise at home to support the treatment's continued ffectiveness. However, such home treatment probably does not affect the reoccurrence rate of posterior canal BPPV.[16]

Figure 3: Brandt-Daroff exercises. The patient sits upright, turns her head 45 degrees to the left, then lies down quickly on her right side for 10 seconds. After returning to an upright seated position, the patient turns her head 45 degrees to the right, lies down quickly on her left side for 10 seconds, then returns to an upright seated position.



Surgery

If head maneuvers and vestibular rehabilitation exercises are ineffective in controlling symptoms, surgery is sometimes considered. The goal of surgery is to stop the inner ear from transmitting false signals about head movement to the brain. Several surgical approaches are possible; however, a procedure called *posterior canal plugging*, also called fenestration and occlusion of the posterior canal, is preferable to other methods. These include removing the balance organs with a labyrinthectomy; severing the vestibular portion of the vestibulo-cochlear nerve with a vestibular nerve section, thus terminating all vestibular signals from the affected side; or severing the nerve that transmits signals from an individual canal with a singular neurectomy.

Canal plugging stops the movement of particles within the posterior semicircular canal with minimal impact on the rest of the inner ear. This procedure should not be considered until the diagnosis of BPPV is certain and all maneuvers or exercises have been attempted and found ineffective.[17] The surgery poses a small risk to hearing; some studies show it to be effective in 85% to 90% of individuals who have had no response to any other treatment,[18] although further research is recommended.[1]

Medication

Motion sickness medications are sometimes helpful in controlling the nausea associated with BPPV and are sometimes used to help with acute dizziness during particle repositioning maneuvers. Otherwise, medications are rarely considered beneficial. Medication that suppresses vestibular function in the long term can interfere with a person making necessary adaptations to symptoms or remaining physically active because of side-effects such as drowsiness. The American Academy of Otolaryngology—Head and Neck Surgery recommends against using vestibular suppressant medications, including antihistamines and benzodiazapines, to control BPPV.[5] Likewise, the American Academy of Neurology reports that there is no evidence supporting the routine use of medication to treat the disorder.[1]

Wait-and-see

Sometimes, adopting a “wait-and-see” approach is used for BPPV. Physicians often choose to monitor patients with BPPV before attempting treatment because it frequently resolves without intervention.[1] This may also be the approach taken with rare variants of BPPV that occur spontaneously or after maneuvers and exercises.

Coping strategies during this wait-and-see phase can involve modifying daily activities to help minimize symptoms. For example, this may

involve using two or more pillows while in bed, avoiding sleeping on the affected side, and rising slowly from bed in the morning. Other modifications include avoiding looking up, such as at a high cupboard shelf, or bending over to pick up something from the floor. Patients with BPPV are also cautioned to be careful when positioned in a dentist's or hairdresser's chair, when lying supine, or when participating in sports activities.

Finding diagnosis and treatment for BPPV

A list of vestibular disorder specialists is available from the Vestibular Disorders Association (VEDA) Web site at www.vestibular.org/find-medical-help.php. This provider directory is annotated to indicate those specialists who are trained to perform canalith repositioning maneuvers.

Additional resources

Some helpful documents available from VEDA:

- Benign Paroxysmal Positional Vertigo (BPPV)—What You Need to Know (Book B-8)
- Inner Ear Surgeries Meant to Control Vertigo/Disequilibrium (Pub. T-6)
- Vestibular Rehabilitation: An Effective, Evidenced-Based Treatment (Pub. F-7)

Video demonstrations of various particle repositioning head maneuvers are available at www.neurology.org/cgi/content/full/70/22/2067/DC2.

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