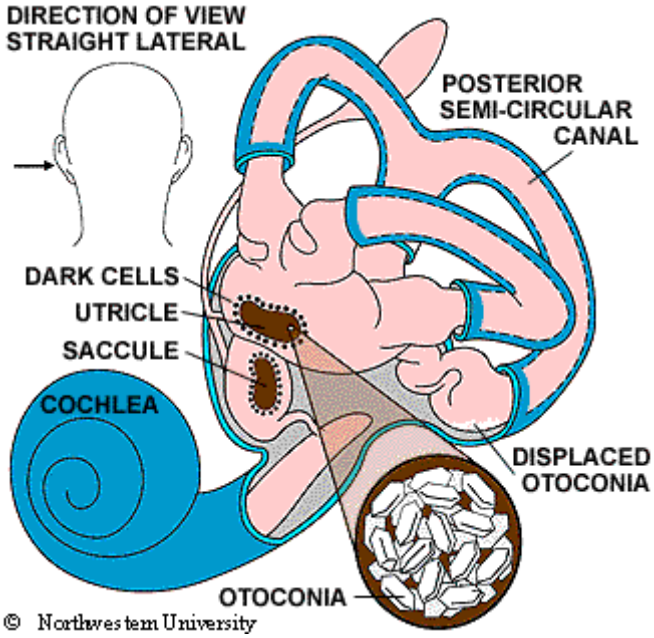
BENIGN PAROXYSMAL POSITIONAL VERTIGO

Timothy C. Hain, MD



In Benign Paroxysmal Positional Vertigo (BPPV) dizziness is generally thought to be due to debris which has collected within a part of the inner ear. This debris can be thought of as "ear rocks", although the formal name is "otoconia". Ear rocks are small crystals of calcium carbonate derived from a structure in the ear called the "utricle" (figure1). While the saccule also contains otoconia, they are not able to migrate into the canal system. The utricle may have been damaged by head injury, infection, or other disorder of the inner ear, or may have degenerated because of advanced age. Normally otoconia appear to have a slow turnover. They are probably dissolved naturally as well as actively reabsorbed by the "dark cells" of the labyrinth (Lim, 1973, 1984), which are found adjacent to the utricle and the crista, although this idea is not accepted by all (see Zucca, 1998, and Buckingham, 1999).

BPPV is a common cause of dizziness. About 20% of all dizziness is due to BPPV. While BPPV can occur in children (Uneri and Turkdogan, 2003), the older you are, the more likely it is that your dizziness is due to BPPV. About 50% of all dizziness in older people is due to BPPV. In one study, 9% of a group of urban dwelling elders were found to have undiagnosed BPPV (Oghalai et al., 2000).

The symptoms of BPPV include dizziness or vertigo, lightheadedness, imbalance, and nausea. Activities which bring on symptoms will vary among persons, but symptoms are almost always precipitated by a change of position of the head with respect to gravity. Getting out of bed or rolling over in bed are common "problem" motions .

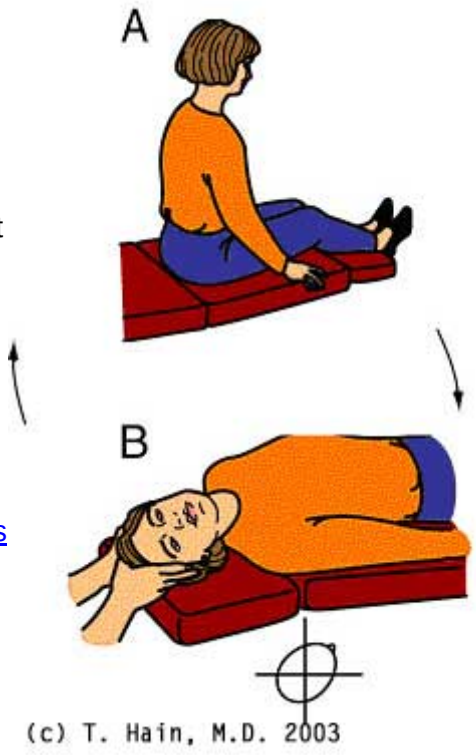
Because people with BPPV often feel dizzy and unsteady when they tip their heads back to look up, sometimes BPPV is called "top shelf vertigo." Women with BPPV may find that the use of shampoo bowls in beauty parlors brings on symptoms. A Yoga posture called the "down dog", or Pilates are sometimes the trigger. An intermittent pattern is common. BPPV may be present for a few weeks, then stop, then come back again.

WHAT CAUSES BPPV?

The most common cause of BPPV in people under age 50 is head injury . The head injury need not be that direct - -even whiplash injuries have a substantial incidence of BPPV (Dispenza et al, 2011). There is also a strong association with migraine (Ishiyama et al, 2000). In older people, the most common cause is degeneration of the vestibular system of the inner ear. BPPV becomes much more common with advancing age (Froeling et al, 1991). Viruses affecting the ear such as those causing vestibular neuritis and Meniere's disease are significant causes.

Occasionally BPPV follows surgery, including dental work, where the cause is felt to be a combination of a prolonged period of supine positioning, or ear trauma when the surgery is to the inner ear (Atacan et al 2001). While rarely encountered, BPPV is also common in persons who have been treated with ototoxic medications such as gentamicin (Black et al, 2004). In half of all cases, BPPV is called "idiopathic," which means it occurs for no known reason. Other causes of positional symptoms are discussed here.

HOW IS THE DIAGNOSIS OF BPPV MADE?



A physician can make the diagnosis based on history, findings on physical examination, and the results of vestibular and auditory tests. Often, the diagnosis can be made with history and physical examination alone. The figure to the right illustrates the Dix-Hallpike test. In this test, a person is brought from sitting to a supine position, with the head turned 45 degrees to one side and extended about 20 degrees backward. A positive Dix-Hallpike tests consists of a burst of nystagmus (jumping of the eyes). The eyes jump upward as well as twist so that the top part of the eye jumps toward the down side. Click here to see a movie of BPPV nystagmus. (13 meg download). The test can be made more sensitive by having the patient wear Frenzel goggles or a video goggle. Most doctors that specialize in seeing dizzy patients have these in their office.

With respect to history, the key observation is that dizziness is triggered by lying down, or on rolling over in bed. Most other conditions that have positional dizziness get worse on standing rather than lying down (e.g. orthostatic hypotension). There are some rare conditions that have symptoms that resemble BPPV. Patients with certain types of central vertigo such as the spinocerebellar ataxias may have "bed spins" and prefer to sleep propped up in bed (Jen et al, 1998). These conditions can generally be detected on a careful neurological examination and also are generally accompanied by a family history of other persons with similar symptoms.

Electronystagmography (ENG) testing may be needed to look for the characteristic nystagmus (jumping of the eyes) induced by the Dix-Hallpike test (also see here PC BPPV). It has been claimed that BPPV accompanied by unilateral lateral canal paralysis is suggestive of a vascular etiology (Kim et al, 1999). For diagnosis of BPPV with laboratory tests, it is important to have the ENG test done by a laboratory that can measure vertical eye movements. A magnetic resonance imaging (*MRI*) scan will be performed if a stroke or brain tumor is suspected. A rotatory chair test may be used for difficult diagnostic problems. It is possible but uncommon (5%) to have BPPV in both ears (bilateral BPPV).

HOW IS BPPV TREATED?

BPPV has often been described as "self-limiting" because symptoms often subside or disappear within 2 months of onset (Imai et al, 2005). BPPV is not life-threatening. One can certainly opt to just wait it out.

No active treatment (wait/see):

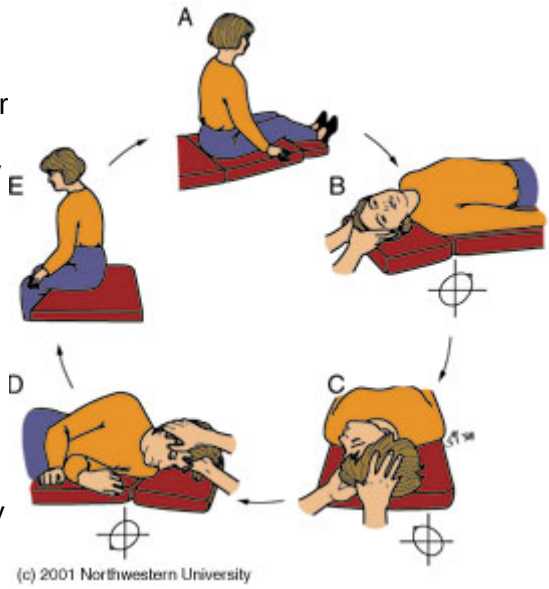
If you decide to wait it out, certain modifications in your daily activities may be necessary to cope with your dizziness. Use two or more pillows at night. Avoid sleeping on the "bad" side. In the morning, get up slowly and sit on the edge of the bed for a minute. Avoid bending down to pick up things, and extending the head, such as to get something out of a cabinet. Be careful when at the dentist's office, the beauty parlor when lying back having ones hair washed, when participating in sports activities and when you are lying flat on your back.

Symptoms tend to wax and wane. Motion sickness medications are sometimes helpful in controlling the nausea associated with BPPV but are otherwise rarely beneficial.

As BPPV can last for much longer than 2 months, in our opinion, it is better to treat it actively and be done with it rather than taking the wait/see approach.

OFFICE TREATMENT OF BPPV: The Epley and Semont Maneuvers

There are two treatments of BPPV that are usually performed in the doctor's office. Both treatments are very effective, with roughly an 80% cure rate, (Herdman et al, 1993; Helminski et al, 2010). If your doctor is unfamiliar with these treatments, you can find a list of clinicians who have indicated that they are familiar with the maneuver from the Vestibular Disorders Association (VEDA) .



The maneuvers, named after their inventors, are both intended to move debris or "ear rocks" out of the sensitive part of the ear (posterior canal) to a less sensitive location. Each maneuver takes about 15 minutes to complete. The **Semont maneuver** (also called the "liberatory" maneuver) involves a procedure whereby the patient is rapidly moved from lying on one side to lying on the other (Levrat et al, 2003). It is a brisk maneuver that is not currently favored in the United States, but it is 90% effective after 4 treatment sessions. In our opinion, it is equivalent to the Epley maneuver as the head orientation with respect to gravity is very similar, omitting only 'C' from the figure to the right.

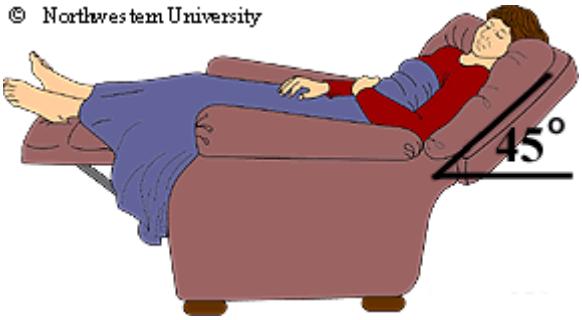
The **Epley maneuver** is also called the particle repositioning or canalith repositioning procedure. It was invented by Dr. John Epley, and is illustrated in figure 2. Click here for a low bandwidth animation. It involves sequential movement of the head into four positions, staying in each position for roughly 30 seconds. The recurrence rate for BPPV after these maneuvers is about 30 percent at one year, and in some instances a second treatment may be necessary.

When performing the Epley maneuver, caution is advised should neurological symptoms (for example, weakness, numbness, visual changes other than vertigo) occur. Occasionally such symptoms are caused by compression of the vertebral arteries (Sakaguchi et al, 2003), and if one persists for a long time, a stroke could occur. If the exercises are being performed without medical supervision, we advise stopping the exercises and consulting a physician. If the exercises are being supervised, given that the diagnosis of BPPV is well established, in most cases we modify the maneuver so that the positions are attained with body movements rather than head movements.

After either of these maneuvers, you should be prepared to follow the instructions below, which are aimed at reducing the chance that debris might fall back into the sensitive back part of the ear.

INSTRUCTIONS FOR PATIENTS AFTER OFFICE TREATMENTS (Epley or Semont maneuvers)

1. *Wait for 10 minutes after the maneuver is performed before going home*. This is to avoid "quick spins," or brief bursts of vertigo as debris repositions itself immediately after the maneuver. Don't drive yourself home.



2. *Sleep semi-recumbent for the next night*. This means sleep with your head halfway between being flat and upright (a 45 degree angle). This is most easily done by using a recliner chair or by using pillows arranged on a couch (see figure 3). During the day, try to keep your head vertical. You must not go to the hairdresser or dentist. No exercise which requires head movement. When men shave under their chins, they should bend their bodies forward in order to keep their head vertical. If eye drops are required, try to put them in without tilting the head back. Shampoo only under the shower. Some authors suggest that no special sleeping positions are necessary (Cohen, 2004; Massoud and Ireland, 1996). We, as do others, think that there is some value (Cakir et al, 2006)

3. For at least one week, *avoid provoking head positions* that might bring BPPV on again.

- Use two pillows when you sleep.
- Avoid sleeping on the "bad" side.
- Don't turn your head far up or far down.

Be careful to avoid head-extended position, in which you are lying on your back, especially with your head turned towards the affected side. This means be cautious at the beauty parlor, dentist's office, and while undergoing minor surgery. Try to stay as upright as possible. Exercises for low-back pain should be stopped for a week. No "sit-ups" should be done for at least one week and no "crawl" swimming. (Breast stroke is OK.) Also avoid far head-forward positions such as might occur in certain exercises (i.e. touching the toes). Do not start doing the Brandt-Daroff exercises immediately or 2 days after the Epley or Semont maneuver, unless specifically instructed otherwise by your health care provider.

4. *At one week after treatment, put yourself in the position that usually makes you dizzy*. Position yourself cautiously and under conditions in which you can't fall or hurt yourself. Let your doctor know how you did.

Variant maneuvers:

Comment: Massoud and Ireland (1996) stated that post-treatment instructions were not necessary. While we respect these authors, at this writing (2002), we still feel it best to follow the procedure recommended by Epley.

While some authors advocate use of vibration in the Epley maneuver, we have not found this useful in a study of our patients (Hain et al, 2000). Use of an antiemetic prior to the maneuver may be helpful if nausea is anticipated.

Some authors suggest that position 'D' in the figure is not necessary (e.g. (Cohen et al. 1999; Cohen et al. 2004). In our opinion, this is a mistake as mathematical modeling of BPPV suggests that position 'D' is the most important position (Squires et al, 2004). Mathematical modeling also suggests that position 'C' is probably not needed. In our opinion, position 'C' has utility as it gives patients a chance to regroup between position 'B' and 'D'.

The "Gans" maneuver. This is a little used treatment maneuver, called the "Gans maneuver by it's inventor (R. Gans, Ph.D.), that is a hybrid between the Epley and Semont maneuvers. It incorporates the head orientations to gravity of "B" and "D" in the Epley figure above, using the body positions of the Semont maneuver. It leaves out position 'C' in the figure above. There is too little published experience with this maneuver to say whether it is as effective as the Epley/Semont but we suspect that it has the same efficacy, as it uses the same head orientations with respect to gravity.

WHAT IS THE PROOF THAT THE EPLEY/SEMONT MANEUVERS WORK ?

Many patients have been reported in controlled studies. The median response in treated patients was 81%, compared to 37.% in placebo or untreated subjects. A metanalysis published in 2010 indicated that there is very good evidence that the Epley maneuver (CRP) is effective (Helminski et al, 2010). See here for the details.

WHAT IF THE MANEUVERS DON'T WORK?

The office maneuvers are effective in about 80% of patients with BPPV. If you are among the other 20 percent, your doctor may wish you to proceed with the home Epley exercises, as described below. If a maneuver works but symptoms recur or the response is only partial (about 40% of the time according to Smouha, 1997), another trial of the maneuver might be advised. When all maneuvers have been tried, the diagnosis is clear, and symptoms are still intolerable, surgical management (posterior canal plugging) may be offered.

Occasional patients travel to a facility where a device is available to position the head and body to make the maneuvers more effective. See this page for more information about this option.

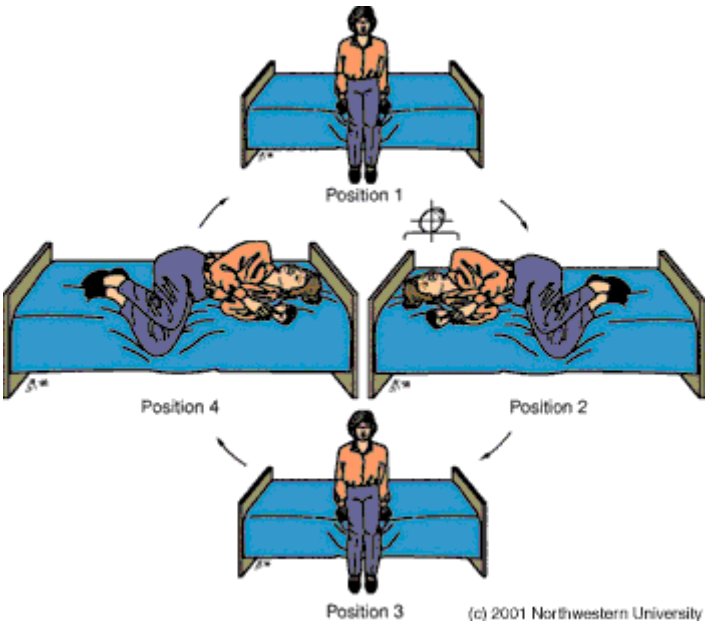
BPPV often recurs. About 1/3 of patients have a recurrence in the first year after treatment, and by five years, about half of all patients have a recurrence (Hain et al, 2000; Nunez et al; 2000; Sakaida et al, 2003). If BPPV recurs, in our practice we usually retreat with one of the maneuvers above. While daily use of exercises would seem sensible, we did not find it to prevent recurrence (Helminski et al, 2005; Helminski and Hain, 2008).

In some persons, the positional vertigo can be eliminated but imbalance persists. This may be related to utricular damage (Hong et al, 2008). See this page for some other ideas. In these persons it may be reasonable to undertake a course of generic vestibular rehabilitation, as they may still need to compensate for a changed utricular mass or a component of persistent vertigo caused by cupulolithiasis. Conventional vestibular rehabilitation has some efficacy, even without specific maneuvers. (Angeli, Hawley et al. 2003; Fujino et al ,1994))

HOME TREATMENT OF BPPV:

BRANDT-DAROFF EXERCISES

Click here for a low bandwidth animation



The **Brandt-Daroff Exercises** are a home method of treating BPPV, usually used when the side of BPPV is unclear. Their use has been declining in recent years, as the home Epley maneuver (see below) is considerably more effective. They succeed in 95% of cases but are more arduous than the office treatments. These exercises also may take longer than the other maneuvers -- the response rate at one week is only about 25% (Radke et al, 1999). These exercises are performed in three sets per day for two weeks. In each set, one performs the maneuver as shown five times.

1 repetition = maneuver done to each side in turn (takes 2 minutes)

Suggested Schedule for Brandt-Daroff exercises		
Time	Exercise	Duration
Morning	5 repetitions	10 minutes
Noon	5 repetitions	10 minutes
Evening	5 repetitions	10 minutes

Start sitting upright (position 1). Then move into the side-lying position (position 2), with the head angled upward about halfway. An easy way to remember this is to imagine someone standing about 6 feet in front of you, and just keep looking at their head at all times. Stay in the side-lying position for 30 seconds, or until the dizziness subsides if this is longer, then go back to the sitting position (position 3). Stay there for 30 seconds, and then go to the opposite side (position 4) and follow the same routine.

These exercises should be performed for two weeks, three times per day, or for three weeks, twice per day. This adds up to 42 sets in total. In most persons, complete relief from symptoms is obtained after 30 sets, or about 10 days. In approximately 30 percent of patients, BPPV will recur within one year. Unfortunately, daily exercises are not effective in preventing recurrence (Helminski and Hain, 2008). The Brandt-Daroff exercises as well as the Semont and Epley maneuvers are compared in an article by Brandt (1994), listed in the reference section.

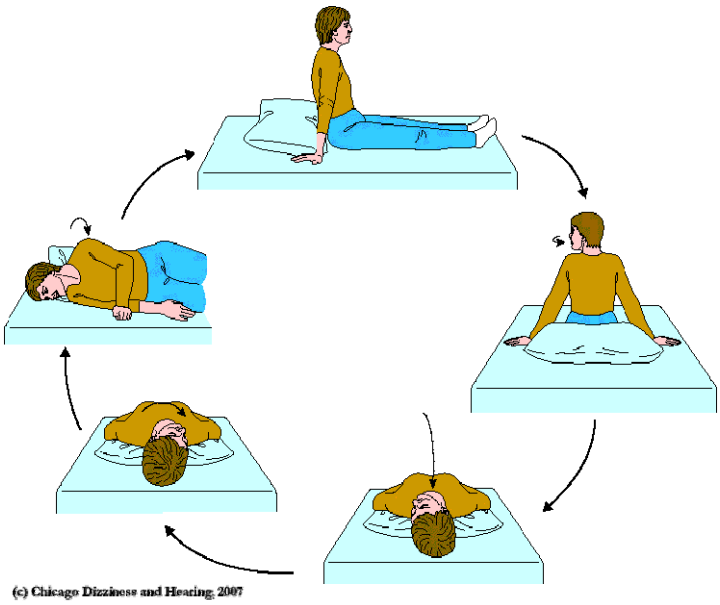
When performing the Brandt-Daroff maneuver, caution is advised should neurological symptoms (i.e. weakness, numbness, visual changes other than vertigo) occur. Occasionally such symptoms are caused by compression of the vertebral arteries (Sakaguchi et al, 2003). In this situation we advise not proceeding with the exercises and consulting ones physician.

Multicanal BPPV (usually mild) often is a consequence of using the Brandt-Daroff exercises.

Other resources:

HOME EPLEY MANEUVER

The Epley and/or Semont maneuvers as described above can be done at home (Radke et al, 1999; Furman and Hain, 2004). We often recommend the home-Epley to our patients who have a clear diagnosis. This procedure seems to be even more effective than the in-office procedure, perhaps because it is repeated every night for a week.

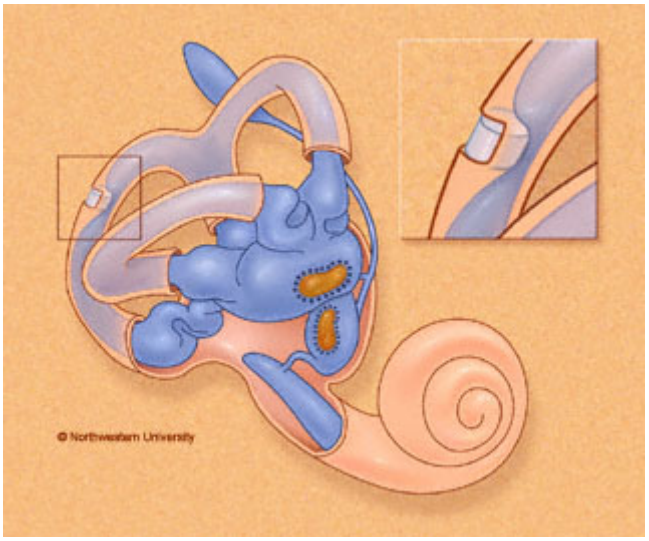


The method (for the left side) is performed as shown on the figure to the right. One stays in each of the supine (lying down) positions for 30 seconds, and in the sitting upright position (top) for 1 minute. Thus, once cycle takes 2 1/2 minutes. Typically 3 cycles are performed just prior to going to sleep. It is best to do them at night rather than in the morning or midday, as if one becomes dizzy following the exercises, then it can resolve while one is sleeping. The mirror image of this procedure is used for the right ear.

There are several problems with the "do it yourself" method. If the diagnosis of BPPV has not been confirmed, one may be attempting to treat another condition (such as a brain tumor or stroke) with positional exercises -- this is unlikely to be successful and may delay proper treatment. A second problem is that the home-Epley requires knowledge of the "bad" side. Sometimes this can be tricky to establish. Complications such as conversion to another canal (see below) can occur during the Epley maneuver, which are better handled in a doctor's office than at home. Finally, occasionally during the Epley maneuver neurological symptoms are provoked due to compression of the vertebral arteries. In our opinion, it is safer to have the first Epley performed in a doctors office where appropriate action can be taken in this eventuality.

SURGICAL TREATMENT OF BPPV

(POSTERIOR CANAL PLUGGING AND SINGULAR NERVE SECTION)



The frequency of surgical treatment has been dropping rapidly in favor of other treatments (Leveque et al, 2007). Only about 1/200 our BPPV patients eventually have this procedure done. Surgery should not be considered until all three maneuvers/exercises (Office Epley, Office Semont, Home Epley) have been attempted and failed.

Surgical treatment of BPPV is not easy -- your local ear doctor will probably have had no experience at all with this operation. Of course, it is always advisable when planning surgery to select a surgeon who has had as wide an experience as possible. Complications are rare (Rizvi and Gauthier, 2002), but nevertheless one should still think carefully about undergoing a procedure that has a 3% risk of unilateral hearing loss.

Indications for surgery:

If the exercises described above are ineffective in controlling symptoms, symptoms have persisted for a year or longer, and the diagnosis is very clear, a surgical procedure called "posterior canal plugging" may be recommended. Canal plugging blocks most of the posterior canal's function without affecting the functions of the other canals or parts of the ear. This procedure poses a small risk to hearing -- about 3%, but is effective in about 85-90% of individuals who have had no response to any other treatment (Shaia et al, 2006). The risk of the surgery to hearing derives from inadvertent breaking into the endolymphatic compartment while attempting to open the bony labyrinth with a drill.

Alternatives to plugging.

Singular nerve section is the main alternative. Dr Gacek (Syracuse, New York) has written extensively about singular nerve section (Gacek et al, 1995). Interestingly, Dr. Gacek is the only surgeon who has published any results with this procedure post 1993 (Leveque et al, 2007). Singular nerve section is very difficult because it can be hard to find the nerve.

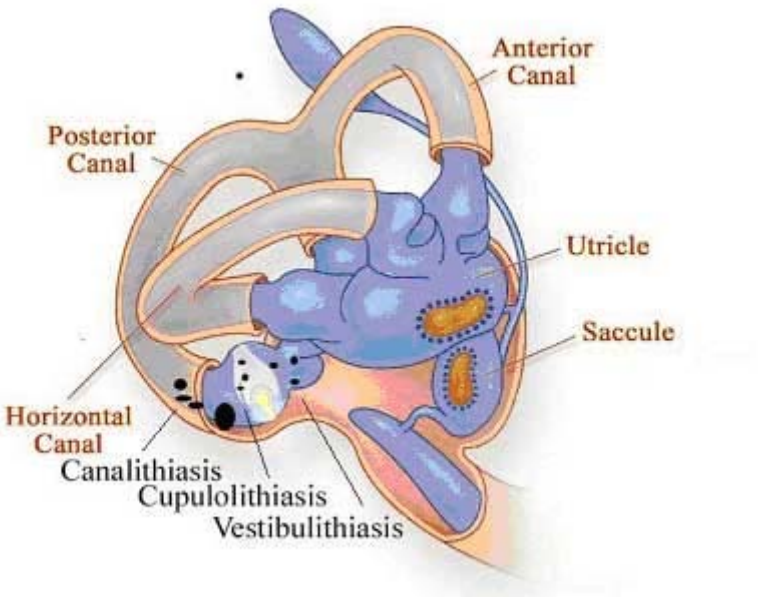
Dr. Anthony (Houston, Texas), advocates laser assisted posterior canal plugging. It seems to us that these procedures, which require unusual amounts of surgical skill, have little advantage over a conventional canal plugging procedure.

Don't do these

There are several surgical procedures that we feel are simply inadvisable for the individual with intractable BPPV. Canal plugging is preferable to all of these. Vestibular nerve section, while effective, eliminates more of the normal vestibular system than is necessary. Similarly, transtympanic gentamicin treatment is generally inappropriate. Labyrinthectomy and sacculotomy are also both inappropriate because of reduction or loss of hearing expected with these procedures.

ATYPICAL BPPV

Lateral Canal BPPV, Anterior Canal BPPV, Cupulolithiasis, Vestibulolithiasis, Multicanal patterns



There are several rarer variants of BPPV which may occur spontaneously as well as after the Brandt-Daroff maneuvers or Epley/Semont maneuvers. They are mainly thought to be caused by migration of otoconial debris into canals other than the posterior canal, the anterior or lateral canal. It is also possible that some are due to other conditions such as brainstem or cerebellar damage, but clinical experience suggests that this is very rare.

There is presently no data reported as to the frequency and extent of these syndromes following treatment procedures. It is the author's estimate that they occur in roughly 5% of Epley maneuvers and about 10% of the time after the Brandt-Daroff exercises. In nearly all instances, with the exception of cupulolithiasis, these variants of BPPV following maneuvers resolve within a week without any special treatment, but when they do not, there are procedures available to treat them.

In clinical practice, atypical BPPV arising spontaneously is first treated with maneuvers as is typical BPPV, and the special treatments as outlined below are entered into only after treatment failure. When atypical BPPV follows the Epley, Semont or Brandt-Daroff maneuvers, specific exercises are generally begun as soon as the diagnosis is ascertained. In patients in whom the exercise treatment of atypical BPPV fails, especially in situations where onset is spontaneous, additional diagnostic testing such as MRI scanning may be indicated. The reason for this is to look for other types of positional vertigo.

Lateral canal BPPV is the most common atypical BPPV variant, accounting for about 3-12 percent of cases (Korres et al, 2002; Hornibrook 2004). Many cases are seen as a consequence of an Epley maneuver. It is diagnosed by a horizontal nystagmus that changes direction according to the ear that is down. More detail about lateral canal BPPV as well as an illustration of a home exercise can be found here

Anterior canal BPPV (discussed in more detail here) is also rare, and a recent study suggested that it accounts for about 2% of cases of BPPV (Korres et al, 2002). It is diagnosed by a positional nystagmus with components of downbeating and (sometimes) torsional movement on taking up the Dix-Hallpike position. More detail about anterior canal BPPV as well as an illustration of a home exercise can be found here

Cupulolithiasis (also see here) is a condition in which debris is stuck to the cupula of a semicircular canal, rather than being loose within the canal. Cupulolithiasis should result in a constant nystagmus. This pattern is sometimes seen (Smouha et al. 1995). Cupulolithiasis might theoretically occur in any canal -- horizontal, anterior or vertical, each of which might have it's own pattern of positional nystagmus.

If cupulolithiasis of the posterior canal is suspected, it seems logical to treat with either the Epley with vibration, or alternatively, use the Semont maneuver. Other maneuvers have been proposed for lateral canal cupulolithiasis. There are no controlled studies of cupulolithiasis to indicate which strategy is the most effective.

Vestibulolithiasis (also see here)is a hypothetical condition in which debris is present on the vestibule-side of the cupula, rather than being on the canal side. For this theory, there is loose debris, close to but unattached to the cupula of the posterior canal, possibly in the vestibule or short arm of the semicircular canal. This mechanism would be expected to resemble cupulolithiasis, having a persistent nystagmus, but with intermittency because the debris is movable. Very little data is available as to the frequency of this pattern, and no data is available regarding treatment.

Multicanal BPPV. If debris can get into one canal, why shouldn't it be able to get into more than one ? It is common to find small amounts of horizontal nystagmus or contralateral downbeating nystagmus in a person with classic posterior canal BPPV. While other explanations are possible, the most likely one is that there is debris in multiple canals. Gradually a literature is developing about these situations (Bertholon et al, 2005).

WHERE ARE BPPV EVALUATIONS AND TREATMENTS DONE?

The Vestibular Disorders Association (VEDA) maintains a large and comprehensive list of doctors, audiologists and physical therapists who indicate that they have proficiency in treating BPPV. Please contact them to find a local treating doctor. We think it is best to select someone who treats BPPV at least on a weekly basis, or if this is not possible, someone who has attended a course on vestibular rehabilitation. Because BPPV is so common, most major cities will have at least one person who fits these criteria.

Acknowledgements

REFERENCES CONCERNING BPPV:

See also the following web pages

- http://www.charite.de/ch/neuro/vertigo.html -- This is a self-treatment Epley protocol.

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