



NIDCD Fact Sheet **Balance Disorders**

Shull Physical Therapy Center provides Vestibular Rehabilitation for Vertigo/BPPV and other Balance disorders. Call for an appointment today at 361-225-2539.

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES · NATIONAL INSTITUTES OF HEALTH · NATIONAL INSTITUTE ON DEAFNESS AND OTHER COMMUNICATION DISORDERS

What is a balance disorder?

A balance disorder is a condition that makes you feel unsteady or dizzy, as if you are moving, spinning, or floating, even though you are standing still or lying down. Balance disorders can be caused by certain health conditions, medications, or a problem in the inner ear or the brain.

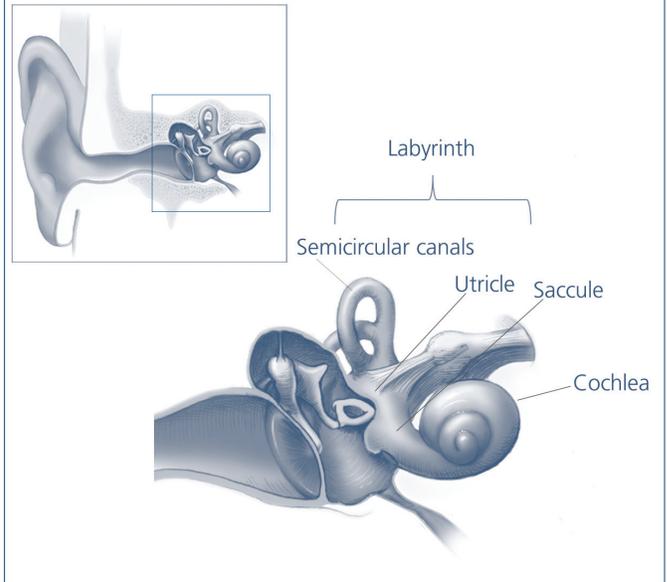
Our sense of balance is primarily controlled by a maze-like structure in our inner ear called the labyrinth, which is made of bone and soft tissue. At one end of the labyrinth is an intricate system of loops and pouches called the semicircular canals and the otolithic organs, which help us maintain our balance. At the other end is a snail-shaped organ called the cochlea, which enables us to hear. The medical term for all of the parts of the inner ear involved with balance is the vestibular system (see Figure 1).

How does the vestibular system work?

Our vestibular system works with other sensorimotor systems in the body, such as our visual system (eyes) and skeletal system (bones and joints), to check and maintain the position of our body at rest or in motion. It also helps us maintain a steady focus on objects even though the position of our body changes. The vestibular system does this by detecting mechanical forces, including gravity, that act upon our vestibular organs when we move. Two sections of the labyrinth help us accomplish these tasks: the semicircular canals and the otolithic organs.

The semicircular canals are three fluid-filled loops arranged roughly at right angles to each other. They

Figure 1: The vestibular system in relation to the ear



Credit: NIH Medical Arts

tell the brain when our head moves in a rotating or circular way, such as when we nod our head up and down or look from right to left.

Each semicircular canal has a plump base, which contains a raindrop-shaped structure filled with a gel-like substance (see Figure 2). This structure, called the cupula, sits on top of a cluster of sensory cells, called hair cells. The hair cells have long threadlike extensions, called stereocilia, that extend into the gel. When the head moves, fluid inside the semicircular canal moves. This motion causes the cupula to bend and the stereocilia within it to tilt to one side. The tilting action creates a signal that travels to the brain to tell it the movement and position of your head.

Between the semicircular canals and the cochlea lie the otolithic organs, which are two fluid-filled pouches

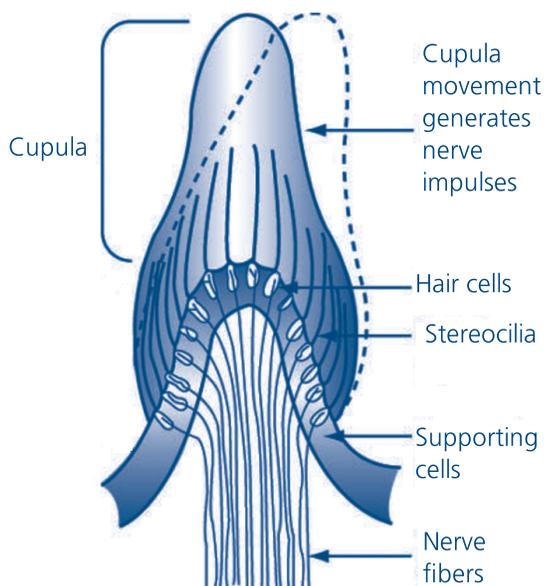
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hearing

balance

Figure 2: The role of the cupula in balance



Credit: NASA

called the utricle and the saccule. These organs tell the brain when our body is moving in a straight line, such as when we stand up or ride in a car or on a bike. They also tell the brain the position of our head with respect to gravity, such as whether we are sitting up, leaning back, or lying down.

Like the semicircular canals, the utricle and the saccule have sensory hair cells. These hair cells line the bottom of each pouch, and their stereocilia extend into an overlying gel-like layer. On top of the gel are tiny grains made of calcium carbonate called otoconia. When you tilt your head, gravity pulls on the grains, which then move the stereocilia. As with the semicircular canals, this movement creates a signal that tells the brain the head's position.

Our visual system works with our vestibular system to keep objects from blurring when our head moves and to keep us aware of our position when we walk or when we ride in a vehicle. Sensory receptors in our joints and muscles also help us maintain our balance when we stand still or walk. The brain receives, interprets, and processes the information from these systems to control our balance.

What are the symptoms of a balance disorder?

If your balance is impaired, you may feel as if the room is spinning. You may stagger when you try to walk or teeter or fall when you try to stand up. Some of the symptoms you might experience are:

- Dizziness or vertigo (a spinning sensation)
- Falling or feeling as if you are going to fall
- Lightheadedness, faintness, or a floating sensation
- Blurred vision
- Confusion or disorientation

Other symptoms are nausea and vomiting, diarrhea, changes in heart rate and blood pressure, and fear, anxiety, or panic. Some people also feel tired, depressed, or unable to concentrate. Symptoms may come and go over short time periods or last for longer periods of time.

What causes a balance disorder?

A balance disorder may be caused by viral or bacterial infections in the ear, a head injury, or blood circulation disorders that affect the inner ear or brain. Many people experience problems with their sense of balance as they get older. Balance problems and dizziness also can result from taking certain medications.

In addition, problems in the visual and skeletal systems and the nervous and circulatory systems can be the source of some posture and balance problems. A circulatory system disorder, such as low blood pressure, can lead to a feeling of dizziness when we suddenly stand up. Problems in the skeletal or visual systems, such as arthritis or eye muscle imbalance, also may cause balance problems. However, many balance disorders can begin all of a sudden and with no obvious cause.

What are some types of balance disorders?

There are more than a dozen different balance disorders. Some of the most common are:

- **Benign paroxysmal positional vertigo (BPPV) or positional vertigo** is a brief, intense episode of vertigo that occurs because of a specific change in the position of the head. If you have BPPV, you might feel as if you're spinning when you look for an object on a high or low shelf or turn your head to look over your shoulder (such as when you back up your car). You also may experience BPPV when you roll over in bed. BPPV is caused when otoconia tumble from the utricle into one of the semicircular canals and weigh on the cupula. The cupula can't tilt properly and sends conflicting messages to the brain about the position of the head, causing vertigo. BPPV sometimes may result from a head injury or just from getting older.
- **Labyrinthitis** is an infection or inflammation of the inner ear that causes dizziness and loss of balance. It frequently is associated with an upper respiratory infection such as the flu.
- **Ménière's disease** is associated with a change in fluid volume within parts of the labyrinth. Ménière's disease causes episodes of vertigo, irregular hearing loss, tinnitus (a ringing or buzzing in the ear), and a feeling of fullness in the ear. The cause of this disease is unknown. For more information, read the NIDCD fact sheet *Ménière's Disease* at <http://www.nidcd.nih.gov/health/balance/meniere.asp>.
- **Vestibular neuronitis** is an inflammation of the vestibular nerve and may be caused by a virus. Its primary symptom is vertigo.
- **Perilymph fistula** is a leakage of inner ear fluid into the middle ear. It can occur after a head injury, drastic changes in atmospheric pressure (such as

when scuba diving), physical exertion, ear surgery, or chronic ear infections. Its most notable symptom, besides dizziness and nausea, is unsteadiness when walking or standing that increases with activity and decreases with rest. Some babies may be born with perilymph fistula, usually in association with hearing loss that is present at birth.

- **Mal de débarquement syndrome (MdDS)** is a balance disorder in which you feel as if you're continuously rocking or bobbing. It generally happens after an ocean cruise or other sea travel. Usually, the symptoms will go away in a matter of hours or days after you reach land. However, severe cases can last months or even years.

How is a balance disorder diagnosed?

Diagnosis of a balance disorder is difficult. There are many potential causes—including medical conditions and medications.

To help evaluate a balance problem, your doctor may suggest you see an otolaryngologist. An otolaryngologist is a physician and surgeon who specializes in the ear, nose, and throat. An otolaryngologist may request tests to assess the cause and extent of the balance problem depending on your symptoms and health status.

The otolaryngologist may request a hearing examination, blood tests, an electronystagmogram (which measures eye movements and the muscles that control them), or imaging studies of your head and brain. Another possible test is called posturography. For this test, you stand on a special movable platform in front of a patterned screen. The doctor measures how your body moves in response to movement of the platform, the patterned screen, or both.



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How is a balance disorder treated?

The first thing a doctor will do to treat a balance disorder is determine if your dizziness is caused by a medical condition or medication. If it is, your doctor will treat the condition or suggest a different medication.

Your doctor also may describe ways for you to handle daily activities that increase the risk of falling and injury, such as driving, walking up or down stairs, and using the bathroom.

If you have BPPV, your doctor might prescribe a series of simple movements, called the Epley maneuver, to help dislodge the otoconia from the semicircular canal. You begin the Epley maneuver by sitting upright, with the help of a trained therapist, then quickly lie down on your back, turn your head to one side, and wait for a minute or two before sitting back up again (see Figure 3). For some people, one session will be all that is needed. Others might need to repeat the procedure several times at home to relieve their dizziness.

If you are diagnosed with Ménière's disease, your doctor may recommend changes in your diet, such as reducing the use of salt in your food and limiting alcohol and caffeine. Not smoking also may help. Some anti-vertigo or anti-nausea medications may relieve your symptoms, but they can also make you drowsy. Other medications, such as the antibiotic gentamicin or corticosteroids, may be injected behind the eardrum to reach the inner ear. Although gentamicin helps reduce dizziness, it occasionally destroys sensory cells in the cochlea and causes permanent hearing loss. The risk of hearing loss can be lowered if small doses of gentamicin are given off and on until your symptoms decrease. Corticosteroids don't cause hearing loss; however, research is underway to determine if they are as effective as gentamicin. Surgery on the vestibular organ may be necessary if you have a severe case of Ménière's disease.

Figure 3: Dislodging otoconia using the Epley maneuver



Credit: NIDCD

Some people with a balance disorder may not be able to fully relieve their dizziness and will have to develop ways to cope with it on a daily basis. A vestibular rehabilitation therapist can help by developing an individualized treatment plan that combines head, body, and eye exercises to decrease dizziness and nausea.

To reduce your risk of injury from dizziness, avoid walking in the dark. You also should wear low-heeled shoes or walking shoes outdoors and use a cane or walker if necessary. If you have handrails in the home, inspect them periodically to make sure they are safe and secure. Modifications to bathroom fixtures can make them safer. Conditions at work may need to be modified or restricted, at least temporarily. Driving a car may be especially hazardous. Ask your doctor's opinion about whether it's safe for you to drive.

How do I know if I have a balance disorder?

Everyone has a dizzy spell now and then, but the term "dizziness" may mean something different to different people. For some people, dizziness might be a fleeting sensation of spinning, while for others it's intense and

lasts a long time. Experts believe that more than four out of 10 Americans will experience an episode of dizziness significant enough to send them to a doctor.

To help you decide whether or not you should seek medical help for a dizzy spell, ask yourself the following questions. If you answer “yes” to any of these questions, talk to your doctor.

- Do I feel unsteady?
- Do I feel as if the room is spinning around me?
- Do I feel as if I’m moving when I know I’m sitting or standing still?
- Do I lose my balance and fall?
- Do I feel as if I’m falling?
- Do I feel “lightheaded” or as if I might faint?
- Do I have blurred vision?
- Do I ever feel disoriented, such as losing my sense of time or where I am?

How can I help my doctor make a diagnosis?

You can help your doctor make a diagnosis and determine a treatment plan by answering the questions below. Be prepared to discuss this information during your appointment.

1. The best way I can describe my dizziness or balance problem is:
2. How often do I feel dizzy or have trouble keeping my balance?
3. Have I ever fallen?
 - When did I fall?
 - Where did I fall?
 - Under what conditions did I fall?
 - How often have I fallen?

4. These are the medicines I take:

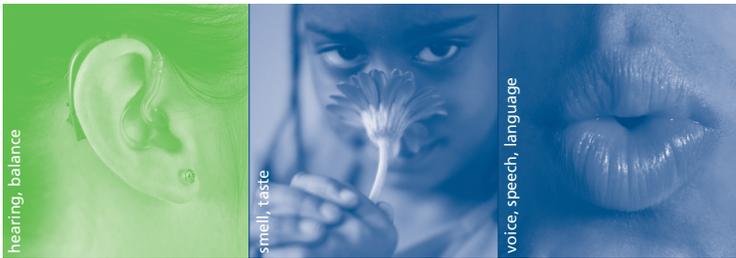
(Include prescription medications and over-the-counter medicine, such as aspirin, antihistamines, or sleep aids.)

- Name of medicine:
- How much (milligrams) _____ and how often (times) per day:
- The condition I take this medicine for is:

What research is being done for balance disorders?

BPPV is the most common balance disorder. Because the source of the problem—displaced otoconia—is located deep within the ear, doctors have had to rely mainly on observation and a medical history to make a diagnosis. Researchers supported by the National Institute on Deafness and Other Communication Disorders (NIDCD) now have created a head-mounted apparatus that uses 3-D animation to map the location of otoconia in the inner ear. The apparatus is built around a pair of infrared video goggles that gather data from eye and head movements and then sends it to a computer program for mapping. A second computer program uses the data to develop a step-by-step guide for repositioning maneuvers to dislodge the otoconia from the semicircular canals. If shown to be effective in clinical trials, the apparatus and its software programs will help doctors more accurately diagnose BPPV and guide repositioning maneuvers to ensure the best possible treatment.

Other NIDCD-supported scientists are looking at the molecular mechanisms that regulate the development of the inner ear. One research team has identified a gene that encodes a protein that helps in the formation of the semicircular canals and their related sensory tissue. Another team has identified a family of genes, called the otopetrins, which help form otoconia



NIDCD supports and conducts research and research training on the normal and disordered processes of hearing, balance, smell, taste, voice, speech, and language and provides health information, based upon scientific discovery, to the public.

in mice. Findings from the mouse study could help researchers determine if otoconia destroyed by aging, medications, infections, or trauma can someday be regenerated in humans with balance problems.

NIDCD-supported scientists also are experimenting with several types of vestibular prostheses, or replacement parts, in balance-impaired animals. Researchers hope these devices will one day be used to compensate for vestibular system loss in people.

One prosthesis uses a head-mounted motion sensor to mimic the ear and brain's natural signaling system. The sensor measures the head's rotation and sends the information to a microprocessor. The microprocessor then converts the signals into electrical impulses and sends them to an electrode implanted in the ear. The electrode stimulates the vestibular nerve, creating a signal that helps the brain move the eyes to compensate for the head's rotation.

A second prosthesis is designed to simulate the movement of fluid within the semicircular canal. In a normal ear, fluid changes help the brain understand the movement and position of the head. The device combines microcontroller circuitry with a tiny mechanical device that increases normal fluid movement to provide a stronger vestibular signal to the brain.

Researchers also are studying the effectiveness of different types of rehabilitative exercises as a treatment option for balance disorders. In one NIDCD-funded study, researchers have used virtual reality technology to simulate the aisles of a grocery store. Using a real cart attached to a custom-built treadmill in front of a projection screen, patients "walk" down aisles, scanning virtual store shelves for items on their list. Researchers are testing whether practicing in the virtual store will lessen episodes of dizziness in the real world, especially in visually complex environments.

Where can I get more information?

The NIDCD maintains a directory of organizations that provide information on the normal and disordered processes of hearing, balance, smell, taste, voice, speech, and language. Please see the list of organizations at <http://www.nidcd.nih.gov/directory>.

Use the following keywords to help you search for organizations that can answer questions and provide printed or electronic information on balance disorders:

- Balance
- Vertigo
- Ménière's disease

For more information, additional addresses and phone numbers, or a printed list of organizations, contact:

NIDCD Information Clearinghouse

1 Communication Avenue
Bethesda, MD 20892-3456
Toll-free Voice: (800) 241-1044
Toll-free TTY: (800) 241-1055
Fax: (301) 770-8977
E-mail: nidcdinfo@nidcd.nih.gov

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Bethesda, MD 20892-3456
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Fax: (301) 770-8977
E-mail: nidcdinfo@nidcd.nih.gov
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