



Let's talk about . . .

ISOLATED OTOLITH DYSFUNCTION (iOD)

This handout is intended as a general introduction to the topic. As each person is affected differently, speak with your health care professional for individual advice.



Key points

- iOD is an umbrella term for one or more problems with the otolith organs (sacculae and utricle).
- The otoliths send information about head position and motion from your inner ear to your brain.
- Otolith dysfunction may either be isolated or involve a problem with another part of the vestibule, especially the semicircular canals.
- Symptoms of iOD include a false sense of non-rotational (not spinning) movement, tilting and drop attacks.
- Two vestibular function tests are used to assess the otoliths.
- Vestibular rehabilitation therapy (VRT) to stimulate the otoliths seems to be helpful.
- Researchers continue to study the best way to define, diagnose and treat iOD.

What is iOD?

Otolith dysfunction is an umbrella term for one or more problems with the otolith organs (sacculae and utricle). People with otolith dysfunction often have

one or more problems with another part of the vestibular system.

Emerging research suggests some people may have isolated otolith dysfunction (iOD). The usual definition of iOD is abnormal function of the otolith organs despite normal function of the semicircular canals. Currently, iOD is not a formally recognized vestibular disorder. It remains a somewhat controversial diagnosis.

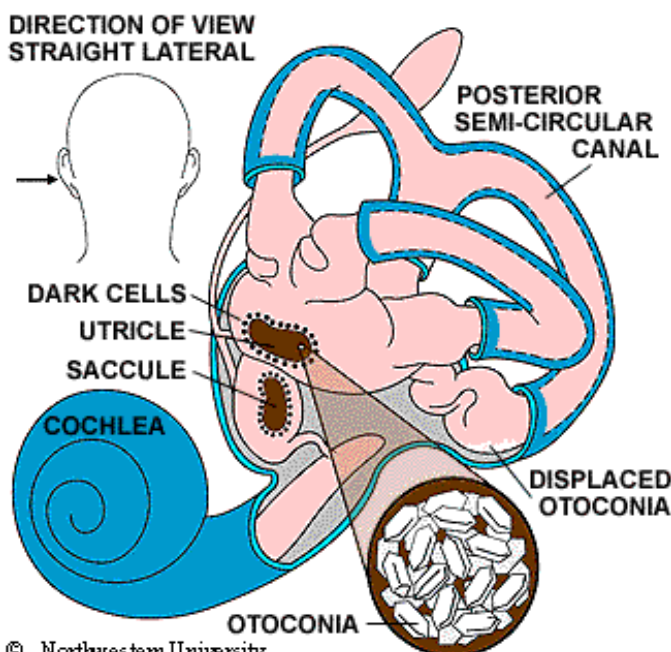
The otoliths are part of the inner-ear balance (vestibular) system. This system is made up of 10 organs of balance – 3 semicircular canals and 2 otolithic organs in each ear. Information from these inner-ear balance sensors travels through the vestibulocochlear nerve (8th cranial nerve) to the brain. The brain makes sense of this information to help you stay upright when standing or moving.

The 3 semicircular canals - superior, posterior, and horizontal – lie at right angles to one another. They act like a gyroscope to detect different types of rotational head movement, for example when you bend down to pick something up or turn your head to look over your shoulder.

The otoliths are made up of two sac-like structures, the sacculae and the utricle. The otoliths detect gravity and motion in all directions. They signal to the brain when your head is tilted. This helps you stay upright and balanced when walking. The otoliths also sense changes in speed of movements in a straight line (linear acceleration) - for example, when you fall, take an elevator, or gather speed or brake in a car. The utricle sits horizontally within the inner ear and mainly senses horizontal motion. The sacculae sits vertically and mainly senses

vertical motion. The saccule also gives information about your head position even when it is not moving.

The otoliths take the form of a chandelier-like structure hanging from hair cells on the ceiling of the inner ear. They are weighted by microscopic crystals of calcium carbonate (otoconia) on a jelly-like membrane. When you tilt your head, the crystals speed up with respect to the hair cells. The hair cells move in one direction at the top and the opposite direction at the bottom (shearing force). This movement is detected by the hair cells, and information about your head position and motion is sent to your brain.



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Inner ear showing location of utricle and saccule

Emerging research suggests the otoliths may also have a role in understanding where your body is in relation to your surroundings (spatial orientation) and memory

What are the causes?

How the function of the utricle and/or saccule become impaired while other parts of the vestibule - particularly the semicircular canals - remain

unaffected is currently unknown. Possibilities suggested by researchers include:

- based on different blood and nerve supply, a vestibular disorder may involve only part of the inner-ear vestibular mechanism such as the otoliths
- virus damage to the utricle and/or saccule without affecting other parts of the inner ear, including the semicircular canals
- selective hydrops (build-up of fluid) of the utricle and/or saccule
- the anatomical structure of the otoliths may make them more sensitive to head trauma than the more resilient structure of the cupula of the semicircular canals

Otolith dysfunction may either be isolated or involve a problem with another part of the vestibule, especially the semicircular canals. Vestibular disorders connected with otolith dysfunction - either because one causes the other or as unconnected companions - include:

- benign paroxysmal positional vertigo (BPPV)
- Ménière's disease
- head trauma, including mild traumatic brain injury (mTBI)
- persistent postural-perceptual dizziness (PPPD)
- acoustic neuroma
- vestibular neuritis
- motion sickness
- vestibular migraine

In many cases, the cause of otolithic dysfunction is unknown (idiopathic).

What are the symptoms?

Symptoms of iOD currently have not yet been clearly defined. Subjective symptoms possibly caused by otolith dysfunction include:

- false sense of non-rotational (not spinning) movement - descriptions include feelings of:
 - rocking or swaying, like being on a boat
 - walking on sponges, pillows or uneven ground
 - the ground shifting or falling away from you
 - floating
 - being pushed or pulled forward, backwards or to the side
 - tilting to one side when standing or sitting upright
 - flipping-over sensation
 - confusion of up and down (inversion illusion)
- imbalance with a quick change in walking speed or when moving from a sitting to standing position
- sensitivity to changes in speed of movement when in a vehicle, for example stop-and-go traffic
- sensitivity to up and down motions, for example riding in an elevator
- recurrent sudden falls that seem to happen without cause (called drop attacks or Tumarkin's otolithic crisis)
- blurred vision with head movement
- feeling of shifting sideways (translation)

How is it diagnosed?

Currently there is no consensus on diagnostic criteria for iOD. Some researchers propose diagnostic criteria based on symptoms and clinical testing, and further grouped by definite iOD and probable iOD.

Malfunctioning otoliths are most often assessed by a specialist, such as an otolaryngologist or an otologist.

The doctor will ask about your symptoms. Try to be as specific as possible about the symptoms and when they get better or worse.

The doctor will also ask about your medical history, including any medications you are taking or recently stopped taking and any conditions you have been diagnosed with in the past. The doctor will also do a thorough physical exam and neurological tests.

You will have diagnostic hearing and vestibular function tests. Currently, two specific tests are used to assess the otoliths:

- cVEMP (Cervical Vestibular Evoked Myogenic Potential) test (assesses the saccules)
- oVEMP (Ocular Vestibular Evoked Myogenic Potential) test (assesses the utricles)

Abnormal VEMP results in both ears might be due to non-vestibular causes. For instance, VEMP responses are affected by aging and results may be inaccurate in those over 65 years of age.

The Subjective Visual Vertical/Horizontal (SVV/H) test (sometimes called the head heave test) also assesses the utricles; however, brain lesions can affect the results.

Two tests to exclude semicircular canal dysfunction will likely be done. These are the caloric test (also called the water test) and the Video Head Impulse test. Some abnormal results can result in some people being misdiagnosed as having iOD despite involvement of the semicircular canals.

The doctor will rule other conditions with some similar symptoms. These include:

- transient ischemic attack (TIA)
- stroke
- vestibular migraine
- mTBI (central issues)

How is it treated and managed?

Although it has not been well studied, vestibular rehabilitation therapy (VRT) seems to be useful. VRT is an exercise-based therapy.

VRT helps strengthen the bond between the body, eyes, brain, and inner ear for most people. During VRT, your symptoms are intentionally provoked in a safe and controlled way to work towards getting your brain used to what makes you uncomfortable. Its overall goal is to increase quality of life by adapting you to your disorder, decreasing your symptoms and improving your overall function.

Research suggests that rehabilitation programs are most effective when they are customized. Therapy for otolith dysfunction includes exercises to stimulate the otoliths such as:

- walking and changing speeds
- up and down movements like gentle bouncing on an exercise ball, squats
- sit to stand and stand to sit
- upright balance exercises with eyes closed

The type, frequency, and intensity of effective exercises varies from person to person.

What to expect in the future

There is still a lot that we do not know about iOD. Researchers are still studying what causes it, how many people have it and the best way to define, diagnose and treat it.

Visit our website

View this and other articles about vestibular disorders – www.balance&dizziness.org.

In addition, find information about how the balance system works, the journey from diagnosis to treatment, building a wellness toolkit, and more.

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If you find the information in this handout helpful, we ask for your help in return. The cause of supporting those affected by balance and dizziness disorders with ad-free, up-to-date, evidence-based information written for Canadians needs you. Please become its champion – [donate to Balance & Dizziness Canada](#).

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