

## SEMICIRCULAR CANAL DEHISCENCE (SCD)

*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

- A rare condition caused by a hole in one of the bony tubes in the inner ear.
- Usually affects the upper semicircular canal.
- Most common in older adults but can happen at any age.
- A hole may happen as part of fetal development or related to an injury or thinning bone later in life.
- Can cause both hearing and balance problems.
- Patients often hear internal sounds such as their own voice, heartbeat, or even eyeball movements.
- Avoiding triggers, tinnitus retraining therapy, using a hearing aid, and treating migraines (if present) may help improve symptoms.
- Surgery to plug the hole is suggested when symptoms are severe.

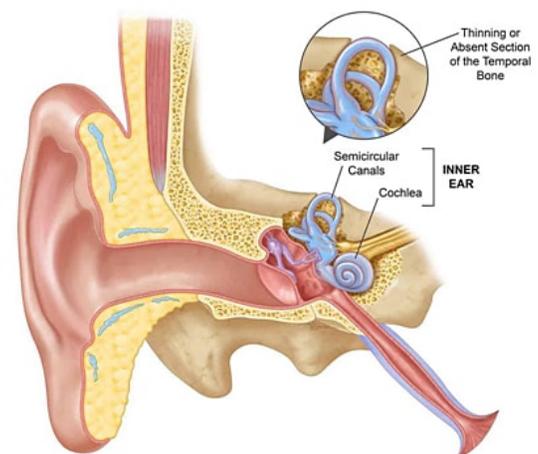
### What is semicircular canal dehiscence?

Semicircular canal dehiscence (SCD) is a collection of hearing and balance symptoms that are caused by a tiny hole (called a dehiscence, pronounced “dee-HISS-ence”) in one or more of the semicircular canals in the inner ear. Usually, SCD affects the superior semicircular canal, but sometimes there is a hole in the posterior semicircular canal. SCD may affect one or both ears.

SCD was first described in 1998.

It is not clear how many people have SCD. It seems to be more common in older adults, but young children can also have SCD. Some people have a hole in the semicircular canal, but do not have symptoms.

It is not clear what causes these holes. In some cases, they may happen as part of fetal development. In other cases, they may be caused by injury or thinning bone later in life. Scientists are still researching this question.



*Semicircular canal dehiscence*

## What are the causes?

The inner ear has two connected parts: the semicircular canals, which help you balance, and the cochlea, which lets you hear. These structures are surrounded by bone and filled with a fluid called endolymph.

There are three semicircular canals in each ear, arranged at right angles to each other. They sense when your head tilts or turns. For example, if you nod your head yes, the endolymph in the superior semicircular canal tries to stay still while the canal moves. (Imagine you are holding a loop of clear garden hose, with one end in each hand, and that it is partly filled with water. If you raise one end of the hose, the water will move toward the other end, because it is staying in one place while the hose is moving.) This makes the endolymph push against specialized hair cells, which send a signal to your brain that your head is moving. This is an important part of the brain's balance system.

The cochlea is a tube that is rolled up so it looks like a snail shell. It turns sound waves into nerve signals that travel to your brain so you can hear. Sound waves enter the ear canal and make the eardrum vibrate, and these vibrations are sent to the stapes (stirrup) bone. This tiny bone pushes on a structure called the oval window, which is at one end of the cochlea, and this causes pressure waves in the fluid (endolymph) inside the cochlea. A structure called the organ of Corti turns these pressure waves into nerve signals. Finally, the pressure waves leave the cochlea through another structure called the round window. The round window acts like a release valve for the cochlea: it moves out when the oval window moves in, and vice versa.

The oval window and the round window are membranes. The rest of the inner ear is rigid because it is encased in bone. Normally, this means that the round window and the oval window are the only parts of the inner ear that move in response to sound waves, so the sound waves stay in the cochlea. But if there is a hole in the bone that covers

one of the semicircular canals, there is now a “third window” in the inner ear. This means that instead of staying in the cochlea, some of the sound waves can leak into the semicircular canal. This leads to several problems:

- The pressure of sound waves in the cochlea is less, so they do not all get turned into nerve impulses. This means that you may not hear some sounds well.
- Sound waves can push against the hair cells in the semicircular canals, so your brain may think your head is moving when it is not.
- Sound waves from inside the body can enter the semicircular canals and then the cochlea, so those internal sounds can be distorted or louder than normal.

Sometimes the hole is up to two mm across. But the hole can be as small as a pinhole and still cause symptoms.

## What are the symptoms?

The symptoms of SCD vary from one person to the next. SCD can cause both hearing and balance symptoms.

Balance symptoms of SCD are often caused by loud sounds or pressure changes (either inside the body, such as when you are coughing, or outside the body, such as when you are taking off or landing in an airplane). They may include:

- Vertigo (a spinning sensation), dizziness (for instance, a sensation of a jolt or being pushed or pulled) and nystagmus (rapid, involuntary eye movements) in response to loud sounds or pressure changes; this is called the Tullio phenomenon when it is caused by sounds and Hennebert's sign when it is caused by pressure changes
- Feeling unsteady or as though you are going to fall (disequilibrium)
- A vision problem called oscillopsia, where what you see blurs or seems to jump around in response to loud sounds or pressure changes

- A feeling of fullness in the ear

Hearing symptoms of SCD may include:

- A form of hearing loss called low-frequency pseudo-conductive hearing loss. “Low-frequency” means it is harder to hear sounds with a lower pitch. “Pseudo-conductive” means that even though some of the hearing test results are similar to conductive hearing loss, your middle ear function is normal.
- Hearing abnormally loud sounds from inside your own body (bone conduction hyperacusis), such as your voice (autophony), your heartbeat, your joints cracking or even your eyeballs moving
- Hearing rhythmic or whooshing noises that don't appear to have an outside source (pulsatile tinnitus)
- Sounds from outside the body, or your own voice, are distorted or hard to hear
- Sensitivity to loud sounds (phonophobia), as they may provoke Tullio phenomenon

## How is it diagnosed?

SCD is usually diagnosed by a specialist, such as an otolaryngologist (an ear, nose and throat or ENT doctor) or a neurologist.

Your doctor will ask about your symptoms and your medical history. Your doctor will also do a thorough physical and neurological exam, including an ear exam.

You will likely have the following diagnostic tests:

- hearing and balance tests, including audiometry, vestibular evoked myogenic potential (VEMP) and videonystagmography (VNG)
- imaging (high-resolution CT scan)

## How is it treated and managed?

At present, the only treatment that addresses the cause of SCD is surgery. But if your symptoms are mild, the drawbacks of surgery may outweigh the

benefits. Your doctor may suggest starting with less invasive ways to manage your symptoms.

Some people find that just knowing what is causing their symptoms is helpful. Other people find their symptoms improve with various techniques, including:

- avoiding triggers such as loud noises and music; earplugs may help to make sounds quieter
- avoiding significant pressure changes, such as scuba diving or flying
- avoiding lifting or straining
- avoiding popping the ear or forceful nose blowing
- tinnitus retraining therapy
- using a hearing aid
- treating migraines, if you have them

Your doctor will want to see you regularly to follow up on how you are doing and see if how your symptoms are changing. SCD will not get better on its own. Your symptoms may stay the same or, without surgery, get worse. Symptoms may increase as you age - the thickness of the bone over the superior semicircular canal decreases.

## Surgery

Surgery for SCD is usually suggested for people whose symptoms are severe and who find that other approaches do not help.

There are several different surgical options, including:

- canal plugging to block the semicircular canal
- canal capping or surfacing to close the hole
- reinforcement of the round or oval window

Which procedure is used will depend on various factors, including:

- where the hole is and how big it is
- the shapes of your ear and skull bones
- your state of health

- how experienced your surgeon is with each procedure

Some techniques have better results than others, and some have a higher risk of hearing loss. Your surgeon will discuss the risks and benefits with you, including potential side effects and how long it usually takes to recover from the procedure.

Some of the symptoms of migraine are similar to those of SCD, and SCD can trigger migraines. If you have migraines, it is important to have them under control before surgery.

Similarly, head injury sometimes causes SCD, but the symptoms of concussion and SCD can be similar or overlap. It is important to be sure that SCD is causing your symptoms before moving ahead with surgery.

Most people who have surgery for SCD have good outcomes, with fewer symptoms and a better quality of life. The most common side effects of surgery include:

- Reduced function of the affected semicircular canal and/or another nearby semicircular canal
- Reduced function of one or both of the otoliths (the utricle and saccule), which are part of the balance system and help to sense head movements
- Problems with vestibular function right after surgery; these usually improve in the weeks after surgery
- Benign paroxysmal positional vertigo (BPPV)
- High-frequency sensorineural hearing loss

People tend to take longer to recover after surgery if they have:

- holes on both sides
- larger holes
- migraines

## What to expect in the future

Researchers are studying the causes of SCD, as well as ways to prevent, diagnose and treat it. Surgeons are also developing new methods and improving existing methods so that they work better and take less time to recover from. Some researchers believe that one day it may be possible to use custom 3-D printing to cover the hole.

## Visit our website

View this and other articles about vestibular disorders – [www.balance&dizziness.org](http://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](https://www.balanceanddizziness.org).

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