VESTIBULAR DISORDERS ASSOCIATION

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Surgery for Peripheral Vestibular Disorders

By the Vestibular Disorders Association

Most people who develop peripheral vestibular problems will never need to consider surgical treatment. With time or medical treatments such as vestibular rehabilitation therapy and dietary changes, the brain adapts to vestibular loss with a complex process called vestibular compensation. However, if the vestibular system is unstable, compensation cannot occur and vertigo and other symptoms do not resolve. In this case, surgical intervention may be considered.

Goals of surgical intervention

Surgical procedures for peripheral vestibular disorders are either corrective or destructive. The goal of corrective surgery is to repair or stabilize inner ear function. The goal of destructive surgery is to stop the production of sensory information or prevent its transmission from the inner ear to the brain. The type of surgery used depends upon the diagnosis and the medical and physical condition of the individual.

Surgical access

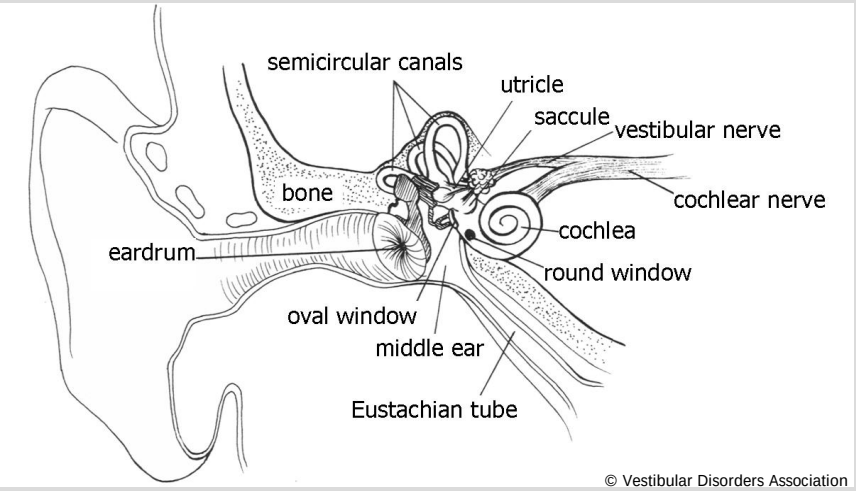
The inner ear organs are accessed in surgery with either a trans-canal approach through the ear canal or with a craniotomy through an opening made in the skull.

Ménière's disease surgery

Ménière's disease produces episodic vertigo, fluctuating hearing loss, tinnitus, and a sensation of ear pressure or fullness. It results from abnormally large amounts of a fluid called endolymph collecting in the inner ear. Surgical procedures used to treat Ménière's disease are designed to either stabilize fluid volume or destroy the transmission of signals traveling from the ear to the brain.

A **vestibular neurectomy** or **vestibular nerve section (VNS)** is performed with a craniotomy and is a destructive procedure that severs the vestibular branch of the acoustic nerve to stop the flow of balance information from the ear to the brain. The brain can then compensate for the loss by using only the signals from the opposite ear to maintain balance.

When a person with unilateral Ménière's disease still has some hearing, VNS is considered effective for treating violent episodic vertigo. However, it is usually avoided in older individuals because of concerns about healing, the brain's ability to compensate for the change in balance information, and the general stress of the surgery. This surgery is performed near the brain. A clear boundary between the



Ear Anatomy

balance and hearing nerves does not always exist, so the nerve may be incompletely severed. The surgery may also cause severe vertigo, nausea, headache, and infection. Other possible bad outcomes include hearing loss, facial nerve damage, development of a cerebrospinal fluid leak, and no improvement in vertigo. Vestibular compensation may be incomplete or unsuccessful VNS is riskier than labyrinthectomy or gentamicin infusion (described below). This surgery requires general anesthesia and a short hospitalization. It is not reversible.

A **labyrinthectomy** is a destructive surgery to remove the balance organs (semicircular canals, utricle, and saccule) so that the brain no longer receives sensory signals about gravity and motion changes from the operated ear. This procedure is highly effective in stopping violent episodic vertigo with unilateral disease, meaning disease that only occurs in one ear. However, because the hearing organ (cochlea) is also sacrificed with a labyrinthectomy, the procedure is typically only considered when a person has already lost all hearing function in the ear. General anesthesia is used for either a craniotomy or transcanal approach.

When the surgery is performed with a transcanal approach, there is a greater risk of not removing all the tissue necessary, resulting in persistent vertigo. Other possible bad outcomes include: facial nerve damage, infection that could involve the brain, a permanent increase in tinnitus, taste disturbance and dry mouth in the immediate postoperative period, incomplete vestibular compensation, and spinal fluid leakage. In addition, destruction of balance function in one ear may cause increased imbalance if disease eventually occurs in the opposite ear.

A **chemical labyrinthectomy** is also known as **gentamicin infusion**, or **transtympanic** or **intratympanic gentamicin treatment.** With a transcanal approach, this destructive procedure introduces an antibiotic into

the middle ear for absorption by the inner ear via the round window, the thin membranes separating the middle ear from the inner ear. The drug destroys the vestibular hair cells so that they cannot send signals to the brain. Different delivery techniques exist to inject or wick the antibiotic to the desired location. This procedure is an alternative to VNS when there is hearing to preserve. Its advantages are that it does not typically require a hospital stay, and the severe vertigo, nausea, and vomiting experienced with labyrinthectomy and VNS are usually avoided. The intended outcome is to control violent episodic vertigo without changing hearing. Possible bad outcomes include continued vertigo as well as hearing loss, which is more common when the drug is given over days rather than weeks. Unsteadiness may be experienced for days, weeks, or months. The exact dosage needed to control vertigo without causing permanent hearing loss is unknown.

Some physicians are using intratympanic steroids in the middle ear as a temporary stabilizing procedure that reduces inflammation and helps control vertigo. Unlike destructive chemical treatments, this procedure is known to preserve or even improve sensorineural hearing loss and problems with tinnitus.

Endolymphatic sac decompression is a stabilizing procedure designed to relieve endolymphatic pressure in the cochlea and vestibular system. The aim of this surgery is to control vertigo and possibly improve tinnitus and stabilize hearing loss. A variety of decompression techniques exist; most are performed via a craniotomy. One method involves allowing the sac to decompress by removing the mastoid bone surrounding it. Other techniques involve inserting a shunt (a tube or strip) into the endolymphatic sac so that, theoretically, excess endolymph can drain out into the mastoid cavity or other location. However, shunts often fail within a year or two when they become clogged with scar tissue. Other possible bad outcomes include hearing loss, new vestibular system damage resulting in increased imbalance and vertigo, postoperative inflammation, infection, cerebrospinal fluid leakage, and facial nerve damage. The effectiveness of decompression techniques in controlling vertigo remains in doubt, which is why destructive procedures are typically preferred.

Perilymph fistula surgery

A perilymph fistula (PLF) can cause dizziness, vertigo, hearing loss, nausea, imbalance, and ear fullness. These symptoms may worsen with changes in air pressure, as well as with exertion and even normal activity. A PLF is an abnormal opening in the fluid-filled inner ear typically occurring in the oval window, the round window, or both. With a PLF, changes in middle ear pressure will directly affect the inner ear and cause symptoms. Many physicians feel that PLFs occur only rarely and are seldom a cause of vertigo. This leads to a range of opinions about whether PLF surgery is effective in controlling vertigo.

Oval or **round window plugging** is a stabilizing surgical procedure designed to patch the fistula in order to stop the leakage of perilymph fluid. Local or general anesthesia is used, the middle ear is entered with a transcanal approach, and tissue taken from the external ear or from behind the ear is used to patch the fistula. An extended postsurgical period of severe activity restriction is advised to help ensure the success of the graft. Possible bad outcomes include a worsening of symptoms and a potential for hearing loss.

Stabilizing the ear with insertion of **pneumatic equalization (PE) tubes** has also been discussed as a method of treating PLFs. A tube is inserted through the eardrum into the middle ear to equalize the air pressure on both sides of the eardrum. This reduces movement of the ear drum, which in turn reduces the movement of the stapes bone against the oval window. The procedure can be done in a doctor's office using local anesthesia. Possible bad outcomes include hearing loss, failure of the hole in the eardrum to close after the tube falls out or is removed, and infection. Opinions vary about using PE tubes with PLFs, including a concern that the tube may create a portal for bacterial infection to travel from the outer ear to the inner ear through the PLF.

BPPV surgery

Benign paroxysmal positional vertigo (BPPV) causes vertigo, dizziness, and other symptoms due to small crystals of calcium carbonate called otoconia that collect within a part of the inner ear. With head movement, the displaced otoconia shift, sending false signals to the brain. It is usually treated successfully without surgery by using in-office BPPV (e.g., Epley) maneuvers. However, **canal partitioning** or **canal plugging** is sometimes used. This stabilizing surgical procedure is designed to stop the movement of endolymph and otoconia within the affected semicircular canal (usually the posterior canal) so that it no longer sends false signals to the brain. A craniotomy is used to access the inner ear organs in order to make a hole in the canal, which is then filled with small bone chips and human fibrinogen glue. Possible bad outcomes include transient or permanent hearing loss, mild but constant postoperative imbalance for several weeks, and continued vertigo.

Superior canal dehiscence surgery

In superior canal dehiscence (SCD), a dehiscence (opening) exists in the bone overlying the superior semicircular canal of the inner ear. There are normally only two mobile windows in the inner ear: the oval window, through which sound energy is transmitted into the inner ear via the stapes bone; and the round window, through which sound energy is dissipated from the inner ear after traveling around the cochlea. SCD creates a third mobile window that can cause conductive hearing loss, vertigo, and oscillopsia, a visual problem where stationary objects to appear to be in motion. These symptoms are evoked by loud noises or by

maneuvers that change middle-ear or intracranial pressure (such as coughing, sneezing, or straining).

Surgical repair of the dehiscence typically uses **canal plugging** to stabilize the canal, reducing the signs and symptoms of SCD. The main risk of this procedure is hearing loss in the affected ear, although this risk is low in patients who have not undergone prior SCD surgery or prior stapedectomy surgery (described below).

Acoustic neuroma surgery

An acoustic neuroma (also called a vestibular schwannoma) is a noncancerous tumor that grows from the tissue of the vestibular branch of the eighth cranial nerve. Disequilibrium is a common symptom; vertigo is less common. Surgical removal of the tumor involves a procedure similar to a VNS. Possible bad outcomes include an inability to remove the entire tumor, hearing loss or deafness, facial nerve damage, and persistent headache.

Otosclerosis surgery

Otosclerosis is a condition that can cause conductive hearing loss, tinnitus, and more rarely vertigo and unsteadiness, because abnormal bony growth fixates the stapes bone, preventing it from vibrating normally against the oval window in response to sound waves. A **stapedectomy** is a corrective transcanal surgery that replaces the stapes with a prosthesis and is performed with either general or local anesthesia. Possible bad outcomes include no hearing improvement or a total loss of hearing in the operated ear, initiation or worsening of tinnitus, increased vertigo, BPPV, and/or PLF.

Further information

To read more about inner ear surgeries used to treat vertigo and disequilibrium, visit www.vestibular.org, where you will also find information about other treatment options, diagnostic testing, and support resources.

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