



Usher syndrome is a family of genetic disorders characterized by early hearing loss and gradual vision loss. There are three distinct types described below.

### Medical Description

The genetic changes responsible for Usher syndrome damage the sensory receptor cells (hair cells) in the inner ear, causing sensorineural hearing loss. This means that a structure in the inner ear, called the cochlea, is not able to detect sound and send information about it to the brain. In Usher syndrome type 1, hair cells in the vestibular portion of the inner ear are also damaged, resulting in balance problems. In many people with Usher syndrome, these problems are present at birth and detected early in life.

Retinitis pigmentosa is the medical term for the type of gradual vision loss experienced by people with Usher syndrome. This vision loss is due to the slow death of rod and cone

photoreceptor cells in the retina.

### Early Symptoms

Parents of children with Usher syndrome are usually the first to notice that their child has limited hearing, so hearing problems are usually diagnosed in the first few years of life. At this point, vision loss will likely not be apparent, although subtle changes might be detected with vision testing.

When vision loss begins to be apparent, the first signs are usually a loss of night vision, followed by the gradual narrowing of a person's vision field.

### Diagnosis

Early hearing loss can be detected and diagnosed with standard audiologic testing, which determines what frequency of sounds a child can hear, and how loud the sounds at these frequencies must be before they are audible.

Children deaf at birth or diagnosed in

	Type 1	Type 2	Type 3
Hearing	Severe deafness in both ears from birth	Moderate to severe hearing loss from birth usually in higher frequencies	No hearing loss at birth, but slow loss of hearing starting in childhood or teens
Vision	Slow vision loss starts with loss of night vision usually in childhood	Slow vision loss starts with loss of night vision in late childhood or teens	Timing and severity of vision loss vary, but most often night vision loss begins in teens
Balance	Balance problems from birth	No balance problems	Minimal/no balance problems at birth, symptoms many get worse with age

Based on a table created by the US National Institute on Deafness & other Communication Disorders.

early life should be screened to detect Usher syndrome including:

- **Visual field** testing measures peripheral vision;
- A detailed **retinal examination**;
- **ERG** (electroretinogram) measures the retina's electrical responses to light flashes. A large contact lens is placed on the eye to record them.
- **ENG** (electronystagmogram) may also be useful, revealing abnormal eye movements that sometimes accompany vision loss.
- **Balance tests** are also done to clarify the diagnosis.

Usher syndrome is typically diagnosed with these tests. However, genetic testing – which can identify the mutated gene in about 50% of cases – is becoming more available.

### Genetic Causes

Mutations (changes) in nine specific genes have been associated with Usher.

**Usher Type 1:** *MYO7A, USH1C, CDH23, PCDH15, SANS*;

**Usher Type 2:** *USH2A, VLGR1, WHRN*;

**Usher Type 3:** *USH3A*

Clinical blood tests for some of these genes are available; ask your genetic counsellor.

### Treatment

Hearing loss in Usher syndrome cannot be reversed; however children diagnosed today are often treated with cochlear implants. These devices stimulate the nerves of the inner ear directly, mimicking

natural hearing. If hearing is less severely affected, hearing aids may be useful.

No treatments are currently approved to prevent or slow the vision loss associated with Usher syndrome. However, it is important to have regular eye exams to avoid serious but treatable complications that might further impair vision, such as cataracts and macular edema.

### Research

Several research groups are working to develop therapies for Usher syndrome including gene therapies in which new genetic material is inserted into the affected retinal cells, to restore function. Gene therapies are specific to only one genetic type of Usher syndrome. A gene therapy, called UshStat, has been approved for clinical trials in the USA. These trials will likely start in the next few months. UshStat is designed to treat defects in the for the MYO7A gene (which causes Usher type 1B). A gene therapy for the WHRN gene (type 2D) is also being tested in the laboratory.

The Foundation Fighting Blindness supports scientists working to understand the causes of vision loss and develop treatments. In addition to gene therapies, our scientists are working on many approaches to slow or even reverse retinal disease.

**Updated September 15, 2011:** Reviewed by Dr. Patrick Yang, Ophthalmology Resident, University of Toronto, and Dr. Bill Stell, The Foundation Fighting Blindness Expert Scientific Advisor and Professor of Cell Biology and Anatomy at the University of Calgary.

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