# What Causes Tinnitus?

## Site and Types of Lesions Producing Tinnitus

*External Auditory Canal Lesions*

Obstruction of the external auditory canal by wax or other foreign bodies may cause a sensation of fullness in the ear with decreased hearing and when this is present, the patient may experience tinnitus. Usually, this is resolved once the obstruction in the ear canal is removed.

*Vascular Lesions*

The heart's pumping and blood circulation normally are only occasionally heard by the patient in the silence of a sound-proofed room. However, if the sounds are heard constantly, they signal a pathologic condition and acquire the properties of real tinnitus. In these instances, the patient perceives a pulsating noise in synchrony with his or her heart rate. When this is present, it needs to be evaluated thoroughly. Vascular noises usually are caused by turbulences within blood vessels. Narrowing of blood vessels as well as vascular tumors may cause type of tinnitus. In addition, other vascular malformations may result in this type of sound. Since most of the vascular lesions associated with pulsating tinnitus can be cured by surgical therapy and since some of the underlying vascular disorders are potentially dangerous, all cases of pulsating tinnitus must undergo a thorough medical work-up before treatment is considered.

*Muscular Lesions*

Some patients may experience a clicking noise radiating from their ear and this can be heard by another person. This can result in a repetitive type of clicking sound and is due to contractions of a muscle within the middle ear. These are involuntary spasms of one of the two muscles attached to the middle ear bones. There are two muscles in the middle ear: the stapedius attached to the stapes bone (stirrup) and the tensor tympani, attached to the malleus (hammer). These muscles normally contract briefly in response to very loud noise. Spasms of the eustachian tube muscles normally are restricted to one side, resulting in click-like sounds. These contractions do not usually open the eustachian tube, but involve the tensor tympani muscle. Since this muscle attaches to the malleus, it thus directionally pulls at the tympanic membrane. Sometimes one can see the movement of the malleus with the clicking sound when this occurs. On occasion, one or both of these muscles may begin to contact rhythmically for no apparent reason for brief periods of time. Because the muscles are attached to one of the middle ear bones, these contractions may result in repetitive sounds in the ear. This clicking sound, although annoying, is harmless and usually subsides without treatment. Should this muscle spasm continue, medical treatment with muscle relaxants or surgery (cutting the spastic muscle may be necessary).

*Opening Movements of the Eustachian Tube*

Opening the eustachian tube occurs by coordinating action of the two palatal muscles (levator and tensor palatini). The normal action that opens the eustachian tube and causes this are swallowing and yawning. Some patients are bothered by the clicking sound in the ear which accompanies the action of swallowing and some patients can produce these sounds voluntarily and elicit this type of noise.

*Central Lesions*

The hearing nerve has approximately 30 thousand fibers within it. Most of these fibers demonstrate spontaneous activity and certain sound frequencies are associated with certain fibers. It is possible that the alterations in this spontaneous activity may generate tinnitus. It has also been demonstrated that the auditory nerve is covered by myelin, and it is in this area that the nerve is more sensitive to vascular compression by blood vessels in the posterior fossa. It is therefore possible that the tinnitus may be secondary to a vascular compression of the auditory nerve. All the fibers of the auditory nerve end in the cochlear nucleus and each fiber may come in contact with as many as 75 to 100 cells of the nucleus. There is also another pathway which is referred to the efferent pathway which is an inhibitory pathway and may be related to the awareness of tinnitus. Specifically, tinnitus may be perceived because of the inability of the efferent system to suppress the tinnitus.

It has been suggested that even though tinnitus may have originated in the cochlea, retrograde changes may occur within the auditory pathway and the tinnitus then becomes a central phenomenon.

*Middle Ear Lesions*

Any dysfunction of the structure(s) of the middle ear (i.e. tympanic membrane, ossicular chain problems) can result in tinnitus. Acute and long-standing inflammation of the middle ear sometimes will result in tinnitus. Often when the middle ear abnormalities are corrected by surgery, the tinnitus disappears. Sometimes in otosclerosis there is an additional component of tinnitus present, probably of cochlear origin, which is usually not improved by surgery.

*Cochlear Lesions*

The cochlea is probably the most common site in the origin of tinnitus. The inner and outer hair cells are connected to the central auditory pathway by two systems. Afferent fibers carry information from the inner ear to the central nervous system. Efferent fibers from the brain go to the inner ear. It is felt that abnormalities of the hair cells, efferent or afferent fiber pathways may give rise to tinnitus.

*A Summary of the Causes of Tinnitus*

Tinnitus may originate from various lesions and from different sites. The auditory system involves highly complicated inner ear structures, many afferent and efferent nerve pathways and a great amount of nuclei that form a complex meshwork. To pinpoint tinnitus to a certain structure becomes questionable. This is demonstrated by patients who have had intractable tinnitus after having surgery on their ear or incurring severe diseases of the ear. In an attempt to relieve the tinnitus, cutting the auditory nerve has been done and yet the tinnitus was persistent, indicating the site of lesion causing the tinnitus must have shifted into the central nervous system.

Tinnitus could be explained by abnormal neural activity in the auditory nerve fibers, which may occur if there is a partial breakdown of the myelin covering of individual fibers. A defect in the hair cell would trigger the discharge of connected nerve fibers. For chronic cochlear disorders, there may also be increased spontaneous activity in the hair cells and neurons resulting in tinnitus. In the auditory nerve there are two different kinds of afferent fibers: Inner hair cell fibers with large diameters and outer hair cells fibers with small diameters. Thus, loss of signals from the cochlea might trigger tinnitus as a manifestation of a functional imbalance between the

two sets of fibers. In addition, other abnormal changes of the cochlear fluids may result in tinnitus.

There is not one type, one site or one origin of tinnitus, but a multitude of types, sites, and origins. It is also unlikely that one hypothesis on the cause of tinnitus could explain all the features.