

PERFORATIONS AND HEARING LOSS

- Tympanoplasty
- Ossicular Reconstruction
- Perforation of Eardrum
- Tympanic Perforation

A perforation is a hole in the ear drum. Perforations occur from infections or injuries to the ear. Childhood perforations most commonly occur from infections. Fortunately, these are generally self-healing. Symptoms of a perforation include drainage from the ear and bloody discharge.

The child's pediatrician will detect the hole or defect in the drum. The first order of treatment is to dry the ear. Antibiotics, decongestants and ear drops are also prescribed. Within several weeks, most perforations following a recent infection heal spontaneously.

An adult with a perforation will generally notice a hearing loss in the ear. Water entering the ear when showering or swimming may be painful and can cause dizziness. Frequent summer ear infections related to swimming may be a symptom of an undetected perforation. Most adults with frequent ear infections, usually have had a history of ear infections in childhood.

Flying with a severe cold can also perforate an eardrum due to changes in air pressure. This is especially true on landing.

The sudden sensation of severe pain and a bloody discharge from the ear may signal a perforation. Medical attention should be sought.

Self-inflicted damage with a cotton swab or other device inserted into the ear is another common cause of eardrum perforation in adults and children. With local care and water protection, the perforation will usually heal spontaneously. In some instances, however, self-inflicted eardrum perforation can force ear drum skin into the middle ear. Therefore, an examination under an operating microscope is usually performed in order to avoid further complications.

If perforations have occurred in the past, the drum may be sufficiently weakened and may not heal by itself. There may be calcium deposits within the drum that prevent the cells from migrating in order to close the hole. There may also be persistent infection which prevents the skin from reestablishing the continuity of the drum. The first treatment should be to completely dry the ear.

The perforation must be protected from water entering the ear canal during bathing or showering. Plugs, cotton or lambs wool soaked in Vaseline can be used to protect the ear. Once the ear becomes completely dry, it may heal spontaneously. If the eardrum does not heal, and the perforation is small, it can sometimes be closed by a simple office procedure.

THE PROCEDURE

The ear surgeon can anesthetize the edges of the eardrum with a strong solution of Xylocaine or inject the ear canal skin with xylocaine. Xylocaine will anesthetize on contact. Once the eardrum is anesthetized, the undersurface can be scratched with a sharp right angled hook. This stimulates the undersurface skin to heal and, in some instances, the

drum will close. At the same time, the ear surgeon places a patch made of cigarette-type paper or other thin substance onto the outer surface of the eardrum. This will provide a matrix to allow the skin to heal underneath the drum.

Perforations do not always heal with these techniques. Thus, in some cases, microsurgery may be necessary to close the perforation. This surgery is called *tympanoplasty*. It is often done on an ambulatory basis, going home on the same day of surgery.

Long standing perforations can be more severe due to infection and erosion of the bones of hearing, which disrupt the bony chain of the middle ear. An audiogram (hearing test) is taken to determine the degree of hearing loss. If the hearing loss is mild and hearing improves upon patching of the hole, then almost certainly the bones of hearing (ossicular chain) are intact. Thus, reconstruction of the eardrum will be a curative procedure.

However, when there is a larger hearing loss, particularly a hearing loss that is not improved by patching of the eardrum, there is very likely to be damage to the bones of hearing. Also in some instances, the perforation is so large that it cannot be patched. There is no way to determine the status of the bones of hearing preoperatively in this situation.

Very active infection which does not dry up with standard techniques, may indicate that there is infection in the mastoid bone. The mastoid bone is the hard bone that you feel if you press behind your ear. Within this bone there is an air filled space called the mastoid cavity. This air filled space connects with the middle ear which is also air filled. Infections of the middle ear can spread into the mastoid cavity causing more serious infection called mastoiditis. A CT scan may be necessary to evaluate this possibility further.

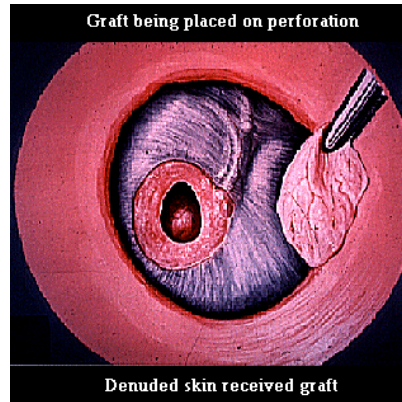
TYMPANOPLASTY

Surgery to reconstruct the tympanic membrane (eardrum) can be performed either under local or general anesthesia. Many patients prefer to be completely asleep. In small perforations, the operation can be easily performed under local anesthesia with intravenous sedation. An incision is made into the ear canal and the remaining eardrum is elevated away from the bony ear canal and lifted forward.

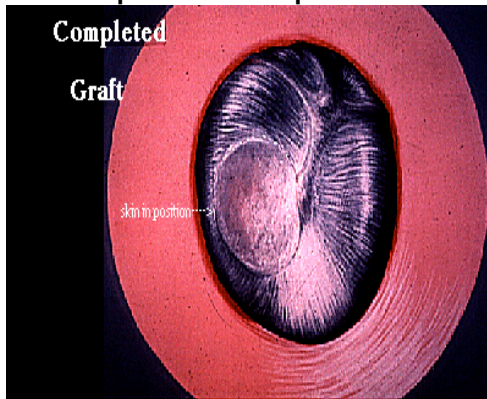
The operating microscope helps to enlarge the view of the ear structures, giving a more detailed image to the ear surgeon. If the perforation is very large or the hole is far forward and away from the view of the surgeon, it may be necessary to perform an incision behind the ear. This elevates the entire outer ear forward, gaining access to the perforation. Once the hole is exposed fully, the perforated remnant is rotated forward, and the bones of hearing are inspected. There may be scar tissue and bands surrounding the bones of hearing. These can be removed either with micro hooks or laser.

Having identified the bones of hearing, the ossicular chain is pressed to determine if the chain is mobile and functioning. If the chain is mobile, then the remaining surgery concentrates on repairing the drum defect.

Tissue is taken either from the back of the ear or from the small cartilaginous lobe of skin in front the ear called the tragus. The tissues are thinned and dried. An absorbable gelatin sponge is placed under the drum to allow for support of the graft. The graft is then inserted underneath the remaining drum remnant and the drum remnant is folded back



onto the perforation to provide closure.



A small amount of Gelfoam is also placed on the outside of the silastic to hold it into position in a so-called sandwich type layer (drawing).

If opened from behind, the ear is then stitched together. Usually, the stitches are buried in the skin and do not have to be removed later. A sterile patch is placed on the outside of the ear canal and the patient returns to the recovery room. Generally, the patient can return home within two to three hours. Antibiotics are given along with a mild pain reliever such as Tylenol or Tylenol with Codeine.

After about ten days, the packing is removed and a good evaluation can then be obtained as to whether the graft was successful. Water is kept away from the ear and blowing of the nose is discouraged. If there are allergies or a cold, further antibiotics and decongestant should be given. Most individuals can return to work after five or six days unless they perform heavy physical labor, in which case the patient can return after two or three weeks.

After three weeks, all packing is completely removed under the operating microscope in the office. It can then be determined whether the graft has fully taken. In over 90 percent of cases, the tympanoplasty procedure is successful and a hearing test is performed at four to six weeks after the operation.

Failure of tympanoplasty can occur either from an immediate infection during the healing period, from water getting into the ear, or from displacement of the graft after surgery. Most patients can expect a full "take" of the grafted eardrum and improvement in hearing. After three to four months, water can be allowed to enter the ear and the patient can even return to swimming.

If ossicular reconstruction is necessary in the tympanoplasty, then an overnight stay is often recommended. There can be imbalance and dizziness immediately after this procedure. Dizziness is uncommon in operations that only involve the eardrum itself. Besides failure of the graft, there may be further hearing loss due to unexplained factors during the healing process. This occurs in less than five percent of individuals undergoing the operation. A total hearing loss from tympanoplasty surgery is rare. This occurs in less than one percent of operations. Postoperative dizziness and imbalance can be present for about a week after surgery and are usually very mild. If the ear becomes infected postoperatively, the risk of dizziness increases. Generally, all imbalance and dizziness will be resolved after a week or two.

Tinnitus or noises in the ear, particularly an echo-type feeling, may be present as a result of the perforation itself. Usually, with improvement in hearing and closure of the eardrum, these sensations clear up. However, tinnitus is unpredictable. In some cases, it can temporarily worsen after the operation. There is no explanation for this temporary situation, but it is rare for the tinnitus to be permanently worse after surgery.

A small nerve goes through the ear called the chorda tympany nerve. This nerve goes to the taste buds of the tongue. Should this nerve be stretched or cut during tympanoplasty surgery, there may be a transient period of one or two months after surgery where there is a slight metallic or salty taste to food. Generally, the nerve connections will regenerate and taste will return to normal. The abnormal taste sensation rarely lasts longer than six months.

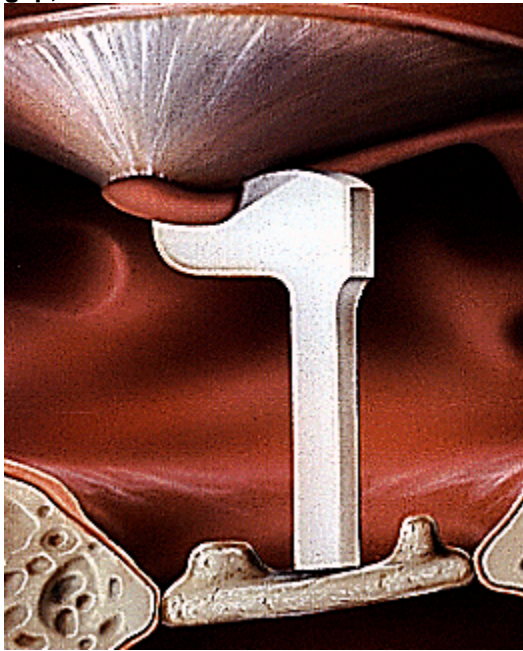
TYMPANOPLASTY WITH OSSICULAR (bone) RECONSTRUCTION

If the bones of hearing are eroded, then ossicular reconstruction (reconstruction of the bones of hearing) may be necessary at the time of tympanoplasty. In some cases, this can be determined before the surgery. In other cases, it only becomes obvious at the time that the ear is completely opened and examined under the microscope.

The ear surgeon must decide whether the bones of hearing can be reconstructed at the time of the reconstruction of the ear drum. In most cases, this is possible if the ear is dry and not infected. The most common bone erosion occurs at the tip of the incus (anvil). This bone normally connects to the stapes (stirrup bone) and the connection is normally only 1.5 mm (1/24th of an inch--lead pencil's lead width) in thickness. With prior infections, the circulation to the bone can become obstructed. Infection can gradually wear away the connection to the point where the bone is no longer in contact with the stapes bone. This is called ossicular discontinuity, a break in the bony connection. One can think of the incus as the player arm of a phonograph and the stapes as the needle. If the player arm is not in contact with the needle, sound will not be transmitted with the same force as it would with a good connection.

Reconstruction of this type of ossicular discontinuity can be performed at the time of tympanoplasty surgery. There are several options. If the gap is small, it can be bridged by inserting a small piece of bone or cartilage taken from the patient at another site (behind the ear or from the lobe of tissue called the tragus in front of the ear). If there is a larger

gap, then the incus bone is removed and modelled into a tooth-like prosthesis,

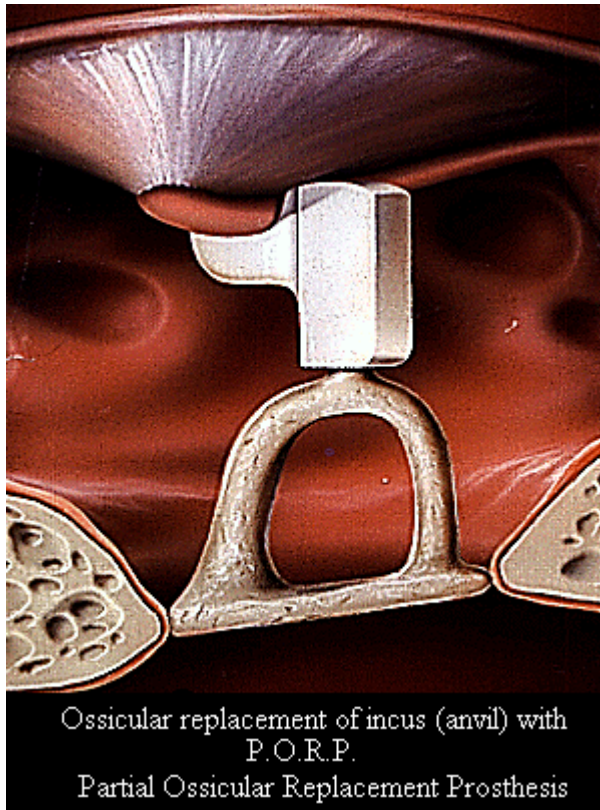


Ossicular replacement
of absent stapes and
incus with T.O.R.P.
(Total ossicular
replacement prosthesis)
conducting sound from
malleus (hammer) to
footplate-bony covering
of vestibule leading
to inner ear

**Incus-Stapes
prosthesis -
a synthetic
bone**

using the operating microscope. This is then reinserted between the stapes and the malleus in order to reestablish continuity of the ossicular chain.

Other options include the insertion of a strut made out of an artificial bone, called hydroxy apatite. This artificial bone is porous and allows for the ingrowth of blood vessels and the complete assimilation of the artificial bone into the individual's middle ear. With the modern day use of hydroxy apatite, there has been a marked reduction in the rejection of ossicular reconstruction prostheses.



Prior prosthetic devices were made out of porous plastics which had a much higher rejection rate.

In other less common ossicular reconstructions, the malleus (hammer) can become fixated by scar tissue or bony ingrowth to the lateral wall of the ear. In this "malleus fixation," the bone must be separated from the canal wall and remodelled. Silastic or a plastic type of sheeting is often placed against the wall to prevent regrowth of new bone. Reconstruction in this instance often requires that the stapes and incus be separated from their connection to stop the transmission of the drill's vibration which would damage the inner ear.

SELECTION AND RESULTS

Tympanoplasty surgery is not always recommended. Chronic sinus or nasal problems such as severe allergies make the operation more difficult. They must be cleared up or controlled prior to tympanoplasty surgery.

The ear and nose are connected by the eustachian tube. If there is active infection in the sinuses or nose, infected materials may block the eustachian tube or even back up into the tube itself. Severe allergies may cause swelling of the tube which is normally lined with mucous membranes. Unless allergies are controlled, swelling will block the eustachian tube and surgical attempts to repair the eardrum will fail.

Tympanoplasty surgery may also not be recommended in very young children whose ears drain with every cold. However, this is a very controversial subject, because if perforations are neglected, they can form Cholesteatomas.

Overall results of tympanoplasty surgery are very successful when precautions are observed. Prior to surgery, all infection should be cleared up. This may require antibiotics as well as weekly cleaning under the operating microscope in the office. Occasionally, clearing all infection may result in spontaneous healing of the perforation if it is not large or too long-standing. Once all infection is cleared, surgery should be scheduled. Ear surgeons generally expect that over 90 percent of tympanoplasty operations will be successful. Success includes closure of the perforation as well as improvement in hearing.

Results of tympanoplasty with ossicular reconstruction vary with the degree of prior damage to the bones of hearing. With an intact, normally mobile chain of ear bones, the restored hearing is generally very good once the hole is closed. Erosion of the incus is usually the most common bony problem and the easiest ossicular problem to repair. Good hearing results are obtained in a high percentage of operations.

Absence of both the stapes bone and the incus creates a much more difficult reconstructive problem. Artificial prostheses which extend from the footplate (diagram) (window of the inner ear) to the malleus (eardrum) are less reliable than other reconstructions, because they bypass the normal lever system of the ossicles. The reconstruction is less stable. During the healing process, it is more likely to become displaced. Even in this difficult situation, two-thirds of the operations bring significant hearing improvement.

If most of the eardrum is absent and the ossicles are destroyed by prior infection or disease, reconstruction will have to be staged into several operations. The first-stage operation reconstructs the eardrum. The second-stage operation, performed six months to one year later, addresses the reconstruction of the bones of hearing.

Mastoid infection, if present, may require that tympanoplasty surgery include mastoidectomy. The mastoid cavity may contain a reservoir of infection. If this material is not cleaned out, the new eardrum will break down after initial success. Thus, it is advisable to obtain a CT scan to visualize the mastoid cavity, if there is a history of prolonged and resistant infection. If the mastoid cavity appears diseased, the tympanoplasty with combined mastoidectomy is often recommended. This operation, termed tympanomastoidectomy, not only involves repairing the eardrum, but during the same operation, the mastoid bone is opened with a drill and all diseased tissue is removed. This procedure may lengthen the operation by 45 minutes or more, but it will improve the chance of a successful result.

Tympanoplasty surgery has been refined to the point of offering the possibility of an intact eardrum and improved hearing in most individuals with perforations and hearing loss. Prolonged medical treatment and the clearing of sinus, nasal and allergy problems are necessary prior to recommending ear surgery.

In a few individuals, other medical problems such as poorly controlled diabetes or heart disease may exclude them as tympanoplasty candidates. However, a great majority of individuals with perforations and hearing loss find improvement with microsurgical tympanoplasty.