

A hole in the drum

An overview of tympanic membrane perforations

BACKGROUND Tympanic membrane perforations are common and can be categorised into either acute or chronic. Acute perforations are usually traumatic or inflammatory in origin and heal spontaneously. Chronic perforations may be associated with underlying progressive disease.

OBJECTIVE To differentiate between safe and unsafe perforations and describe management principles for these conditions.

DISCUSSION The majority of acute tympanic membrane perforations heal spontaneously. Those that do not can be considered for surgical repair. Chronic perforations should be viewed as either safe or unsafe depending on the risk of progression to significant complications. Unsafe perforations are often associated with cholesteatoma (an epidermoid cyst of the middle ear and mastoid air cell system). Cholesteatoma destroys bone and causes serious ear and intracranial complications - surgery is commonly required.

Tympanic membrane defects are regularly seen in general practice. Many will heal spontaneously, requiring no treatment: a few are associated with progressive and destructive disease. Many will heal spontaneously, especially those associated with trauma or acute inflammatory disease.¹ A few are associated with progressive and destructive disease.

Acute tympanic membrane perforations

Infective

If an episode of acute otitis media is followed by an aural discharge of pus and blood (and relief of pain) it is likely that a tympanic membrane perforation has taken place. Treatment is that of the underlying otitis media.

Traumatic

Dry

The classic mechanism of a dry tympanic membrane perforation is a blow to the side of the head with the flat of the hand. The perforation may be obscured by blood but if it can be seen it is generally ragged and irregular in shape (Figure 1). Perforations incurred under these conditions rarely become infected. No attempt should be made to remove the blood (it makes an excellent surgical dressing). In particular, syringing is contraindicated.²

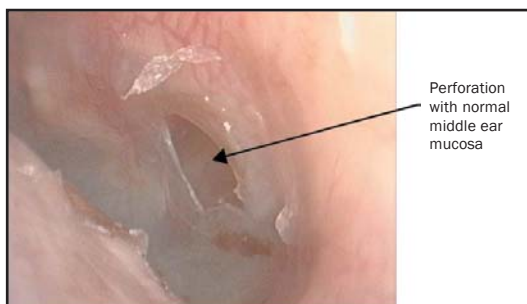


Figure 1. Traumatic perforation

Left ear with a posterosuperior perforation, with sharp irregular margins. (Photo courtesy of Dr John Kelly)

Wet

A perforation that occurs in wet conditions such as in the surf or waterskiing will generally become infected and be associated with purulent discharge. The most common offending organism is *Pseudomonas*.³ A short course of topical antibiotics is safe and effective; thereafter the ear is kept dry. Most traumatic tympanic membrane perforations will heal spontaneously, however, this may be prolonged taking up to nine months. Rarely is surgical repair required.

Chronic perforations

Chronic tympanic membrane perforations can be classified as either safe or unsafe depending on the risk of progression to significant complications. Generally a safe ear, is one in which the perforation is central and an unsafe ear is associated with

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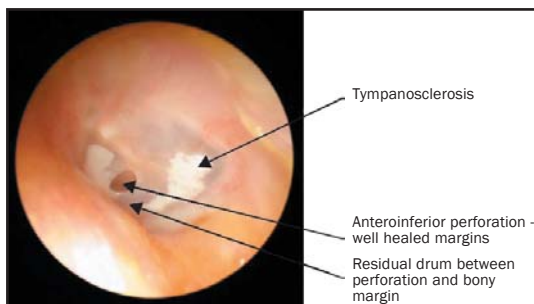


Figure 2. Small central perforation
Left ear with moderate tympanosclerosis (fibrosis of the TM) and an anteroinferior perforation.

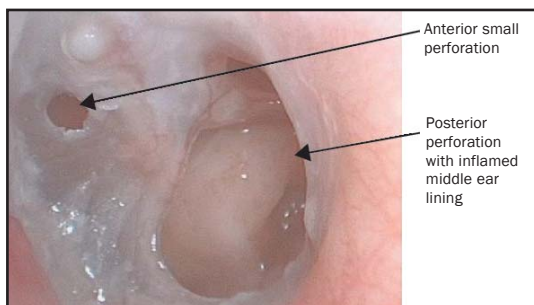


Figure 3. Chronic perforations
Left ear with chronic perforations. (Photo courtesy of Dr John Kelly)

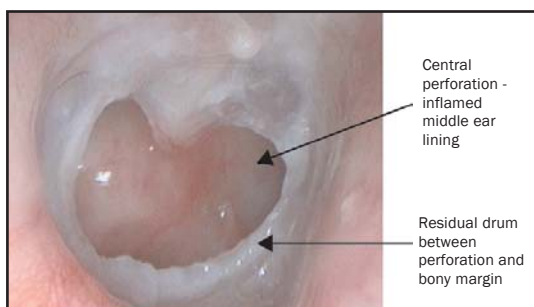


Figure 4. Kidney shaped perforation
Right ear with a large central perforation. (Photo courtesy of Dr John Kelly)

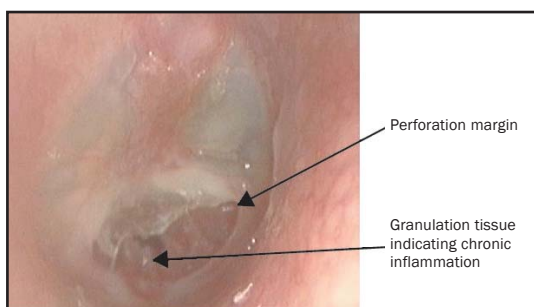


Figure 5. Perforation with granulation tissue
Right ear with an inferior perforation. (Photo courtesy of Dr John Kelly)

a marginal perforation. The exception is a central perforation which never or rarely stops discharging. A chronic tympanic membrane perforation may be associated with underlying destructive and progressive disease, either in the form of osteitis or as a cholesteatoma.

Central perforations

A central perforation is one in which the circumference of the perforation is bounded by residual tympanic membrane. Perforations of this type can be very small (Figure 2), kidney shaped (Figure 3, 4) or very large subtotal. In all of these there is some residual membrane between the defect itself and the bony margins of the ear canal. Such perforations, when dry the greater part of the time, are safe, that is to say, left untreated they will not progress to significant complications.⁴ Any surgical repair is therefore a matter of election, if the patient wishes to have a dry, waterproof ear or to improve hearing.

The exception to this is the ear with a central perforation that never or rarely stops discharging. Very often active granulation tissue can be observed either around the perforation or in the middle ear cavity itself (Figure 5). It can be presumed that osteitis with associated bone destruction is present. Such an ear is not ‘safe’.⁵

Marginal perforations

A marginal perforation is one in which part of the periphery of the perforation is formed by bone (Figure 6). Very often granulation tissue will be seen on the bone and dead squamous epithelium may be seen in the depths of the perforation (Figure 7). Such perforations are almost always ‘unsafe’ and surgery is generally required. The exception is in an old and infirm patient in whom computed tomography (CT) shows significant residual bone between the disease and the dura. An expectant policy can be adopted here but it is important that follow up, perhaps requiring repeated CTs, is undertaken.

What is a cholesteatoma?

Cholesteatoma is an epidermoid cyst which has an outer lining of living skin. There is a lining of squamous epithelium facing inwards, toward the centre of the cyst and outside this is fibrous tissue, inflammatory tissue with granulations and compressed adjoining modified respiratory epithelium from the

middle ear. From this outer layer enzymes, which destroy bone are produced.⁶ The centre of a cholesteatoma becomes filled with dead keratin, the flakes of which bear a passing resemblance to cholesterol crystals and it was this similarity which led early pathologists to label the lesion a cholesteatoma (Figure 8). As dead skin is, in essence, keratin, perhaps the term keratoma, which has not gained general acceptance, would be more appropriate.⁷ As cholesteatoma advances, it destroys bone. The natural history is one of

- dural involvement and invasion (meningitis, brain abscess),
- inner ear involvement (suppurative labyrinthitis with vertigo and total hearing loss), and
- damage to the facial nerve.

When a cholesteatoma has breached the tympanic membrane, secondary infection often occurs with discharge, and it is often this discharge that first brings the condition to the patient's notice. A conductive hearing loss is also very often present.

In these circumstances the offending organism is nearly always a *Pseudomonas*.⁸ This responds much better to topical antibiotics, especially gentamicin 0.3% aqueous or ciprofloxacin. Such treatment in the short term will make it easier to view the tympanic membrane and establish the nature of the underlying process.

Topical antibiotics

It is the author's belief that topical antibiotics are generally more effective in middle ear infections (in which the drum is perforated) than are antibiotics by mouth or systemically, as a high concentration of antibiotic is introduced locally at the site of the infection. The time honoured standby is Sofradex which may be ototoxic* but there is little or no scientific proof to support this supposition. However, any theoretical risk of ototoxicity is minimised by using Sofradex only in short courses while discharge is present. It is presumed that the layer of inflammatory discharge which coats the round window membrane prevents absorption into the inner ear. Therefore, if the discharge is of recent onset, it is reasonable to start with Sofradex. When there is a chronic discharge, a swab should be taken for culture and sensitivity as the causative organisms may be multiple or atypical. In such cases chloramphenicol 0.5% aqueous or ciprofloxacin, which are known not to be ototoxic may be useful.

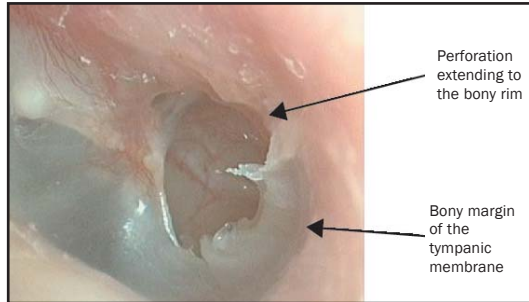


Figure 6. Perforation extending to the bone marginal or unsafe

Left ear with a posteroinferior perforation extending to the bony annulus. (Photo courtesy of Dr John Kelly)

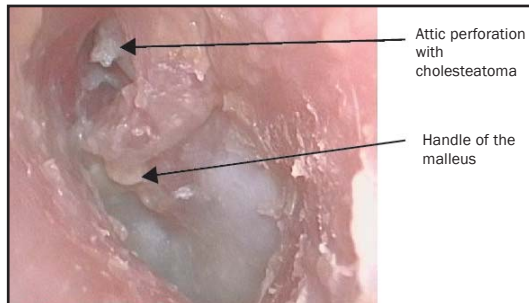


Figure 7. Attic perforation

Left ear with an attic (superior) perforation collecting squamous debris. (Photo courtesy of Dr John Kelly)

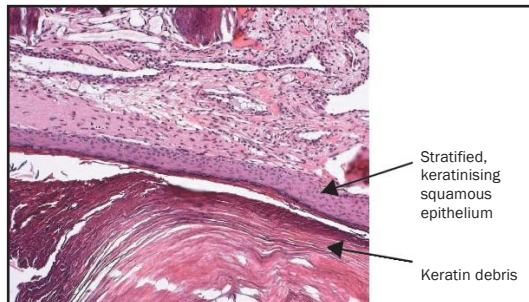


Figure 8. Histopathology of cholesteatoma

(Photo courtesy of Dr Jenny Turner)

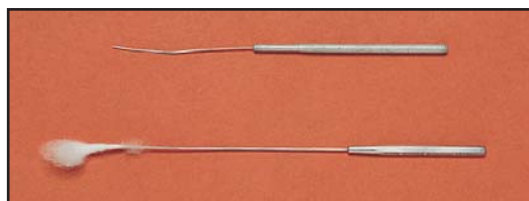


Figure 9. Instruments for cleaning the external ear canal

* Ototoxic: damage to the inner ear producing a sensori-neural hearing loss and/or vertigo. There is more evidence that topical antibiotics are vestibulo-toxic, ie. more likely to damage the balance associated vestibular system than the hearing associated cochlear system.

If the discharge does not respond to topical antibiotics in 10 days or so, it is possible that there is underlying osteitis and the ear is not safe - referral should then be considered.

Cleaning the ear with a perforated drum

In a discharging ear, syringing is contraindicated. No general practitioner can be expected to have the equipment for suction clearance of the ear under magnification.

The use of a cottonwool broche (Figure 9) is one of the simplest and safest ways to clear purulent debris from the ear canal thereby facilitating antibiotic delivery. Loosely woven cottonwool acts as a mop, and should not be inserted more than the 2.5 cm length of the external ear canal.

Surgery

The treatment for an 'unsafe' ear is surgical, which requires some form of mastoid surgery, as well as grafting of the tympanic membrane. The principal aim of surgery is to produce a dry, safe, waterproof ear. Hearing preservation or restoration is more difficult and in the end, depends not on the size of the cholesteatoma or the surgical technique employed but on Eustachian tube function. It is the Eustachian tube which keeps the middle ear full of air and at atmospheric pressure. If the aerated space and the pressure therein are less than they should be, no form of ossicular reconstruction will restore the hearing. Therefore the aim of any mastoid surgery should include the production of a dry, clean ear to which a hearing aid can be fitted.¹⁰

References

1. Kristen S. Traumatic tympanic membrane perforations: complications and management. *Ear Nose Throat J* 1989; 68:503-514.
2. Lindeman P, Edstrom S, Granstrom G, et al. Acute traumatic tympanic membrane perforations. Cover or observe? *Arch Otol Head Neck Surg* 1987; 113(12):1285-1287.
3. Kenney S E. Trauma to the middle ear and temporal bone. In: Cummings et al, eds. *Otol Head Neck Surg* 1998; 3rd edn.
4. Vartianin E, Kansanen M. Tympanomastoidectomy for chronic otitis media without cholesteatoma. *Otol Head Neck Surg* 1992; 106:230-234.
5. Proctor B. Chronic otitis media and mastoiditis in otolaryngology. Paperella M M, Shumrick D, Gluckman J and Meyerhoff W L, eds. 3rd edn, vol 2. Philadelphia: W B Saunders, 1990.
6. Chole R A. Cellular and subcellular events of bone resorption in human and experimental cholesteatoma: the role of osteoclasts. *Laryngoscope* 1984; 94:76.
7. Soldati D, Modry A. Knowledge about cholesteatoma from the first description to modern histopathology. *Otol Neurotol* 2001; 22(6):723-730.
8. Harker, et al. The bacteriology of cholesteatoma. In: McCabe B F, Sade J, Ahramson M, eds. *Cholesteatoma: The first international conference*. New York: Aesculapius Publishers, 1977.
9. Gerker M E. The evolving role of ototopical therapy. *Current Opinion in Otolaryngology Head and Neck Surgery* 2000; 8:454-457.
10. Nadol, et al. *Surgery of the ear and temporal bone*. New York: Raven Press, 1993.

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SUMMARY OF IMPORTANT POINTS

- Acute tympanic membrane perforations are generally traumatic or inflammatory in origin.
- Acute perforations usually require no active treatment other than keeping the ear dry and treating any superimposed infection.
- Chronic perforations should be considered:
 - safe - usually central. Not associated with a high risk of complications and generally do not discharge.
 - unsafe - usually marginal. Associated with a high risk of complications, most commonly cholesteatoma. Usually requires surgery.