Ear examination

A practical guide

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Ear problems represent a significant proportion of cases seen in primary practice – both in paediatric and adult patients. The majority of these ear problems can be diagnosed on the basis of clinical examination of the ear alone. This can be achieved simply with an otoscope and tuning fork without the need for further tests or delay.

The purpose of otoscopic examination is to evaluate the condition of the ear canal, tympanic membrane and the middle ear. However, the ear canal and tympanic membrane are not easy to examine because of their relative inaccessibility and the need for both magnification and illumination. The physician's diagnostic skill with otoscopy depends on a practical understanding of the anatomy of the ear, a suitable choice of otoscope and speculum, and a reliable examination technique.

Equipment

Choosing an otoscope

A suitable otoscope with a pneumatic attachment is essential for reliable and accurate otological examination (*Figure 1*). It is essential that the otoscope is fully charged before each examination. An undercharged otoscope will produce poor light and impart an artificial yellow tinge onto the tympanic membrane. This may potentially lead to the misdiagnosis of straw coloured middle ear fluid. For this reason, an otoscope with a direct power source or re-charging facility is ideal in the examination room setting.

Choosing a speculum

The largest speculum that comfortably fits within the external auditory canal should be chosen when examining the ear. This permits optimal visualisation and illumination. The adult external auditory meatus is about 7 mm in diameter. Therefore, otoscopy should be performed through a speculum of similar size. Such a large speculum allows the entire tympanic membrane to be visualised from one position of the otoscope, and optimises patient comfort during the examination as force is exerted around the entire circumference of the ear canal. In contrast, a smaller speculum transmits force on only one point of the ear canal and is therefore more uncomfortable. Furthermore, otoscopy through an inappropriately small speculum, requires separate examination of each quadrant of the tympanic membrane in order to generate a composite image of the entire structure. This requires constant re-positioning of the speculum within the ear canal.

In adults, a 5 mm inner diameter speculum is appropriate. Children have narrower canals and hence a speculum with an inner diameter of 4 mm is generally suitable. For otoscopy in babies, speculums of 2.5–3.0 mm inner diameter are required.

Examining the ear

Both ears must always be examined, and if disease is unilateral, it is advisable to examine the normal ear first. This allows variation in normal anatomy to be appreciated for that particular patient, and in the case of the discharging ear, avoids the possibility of cross infection.

The outer ear

A systematic examination of the ear always begins with a careful inspection of the auricle and postauricular skin. Any tenderness, obvious abnormalities, discharge or surgical scars should be noted. Evidence of either a localised or generalised skin disorder may also be present. The presence of enlarged pre- or post-auricular lymph nodes can also be assessed.

Using the otoscope

The otoscope is always held by the physician in the hand that correlates with the side of the ear to be examined, ie. the patient's right ear is examined with the otoscope in the examiner's right hand; the left ear is examined with the otoscope in the examiner's left hand. The otoscope is held using one of two techniques:

Figure 1. Otoscope with a pneumatic attachment

- Pencil grip technique: the otoscope is held like a pencil between the thumb and index finger, with the ring and little fingers resting against the patient's temple (*Figure 2*)
- Pistol grip technique: the otoscope is gripped in the palm of the hand and the dorsal aspect of the index finger rests against the patient's cheek (*Figure 3*).

Both techniques ensure that the examiner's hand rests against the side of the patient's face. This means that if the patient moves, the otoscope will move in unison. This technique ensures stability of the physician's view along the ear canal and the patient's comfort during the examination (*Table 1*).

Before inserting the speculum, the tortuous external ear canal must first be straightened. In adults this is achieved by using the free hand to gently lift the pinna upward and backward. In children, the canal is straightened by pulling the pinna horizontally backward (*Figure 2, 3*). It is essential to keep the canal straight throughout the examination as this keeps the tympanic membrane in view. The external meatus is inspected before carefully introducing the speculum into the canal under direct vision.

A systematic approach to examining the ear ensures the identification of any abnormalities. The external canal should always be routinely inspected for infection, debris and bony narrowing such as exostoses. The features of the tympanic membrane and middle ear should be systematically examined – including the malleus, the cone of light, pars tensa and pars flaccida of the ear drum. Through the translucency of the tympanic membrane normal middle ear structures can often be identified (incus and stapes) as well as middle ear anomalies such as fluid (*Figure 4a–h*).

Examining a child

When examining a child, both the head and body need to be gently immobilised to facilitate a safe and thorough otoscopic examination. This is best achieved by examining the child while seated on their parent's lap with the parent restraining the child with one hand placed firmly on the forehead, holding the side of the child's head against their chest and the other arm around the child's arms and body (*Figure 5*).

Figure 2. The pencil grip technique for holding an otoscope

Figure 3. The pistol grip technique for holding an otoscope

Table 1. Advantages of using a large speculum with otoscopy

- Allows superior visualisation and illumination within the ear canal
- Displays the entire tympanic membrane from one position of the otoscope
- Permits an air-tight seal for pneumatic insufflation
- More comfortable for the patient

Tips for successful otoscopy

- Inform the patient (or parent) that the procedure will neither be uncomfortable nor painful
- Show infants the otoscope before commencing the examination to reassure them that it is neither sharp nor hot
- Ensure the otoscope is fully charged
- Use the largest speculum that will fit comfortably in the ear canal
- Hold the otoscope with a technique that ensures the instrument and the patient's head move as a unit
- Ensure that the tortuous cartilaginous portion of the ear canal is straightened by gentle traction of the pinna
- Examine the tympanic membrane systematically
- Pneumatic otoscopy provides a dynamic assessment of the tympanic membrane and middle ear

Table 2. Contraindications to ear syringing

- Suspected or known tympanic perforation
- Ventilation tube in situ
- Signs of otitis externa
- Recent history of otitis media
- History of recent trauma
- History of ossicular chain reconstruction, including stapedectomy surgery

Alternative instrumentation for examination

There are a number of alternative means of illuminating the ear canal and visualising the tympanic membrane. These include a vorascope, headlight and microscope (*Figure 6, 7*). All these methods have the advantage of visualisation of the ear canal – with both hands free – and binocular vision. The otoscope however, has the great advantage of convenience and portability.

Pneumotoscopy

The pneumatic attachment is an indispensable part of the otoscopic instrument (*Figure 1*). Otoscopy permits a two dimensional view of the tympanic membrane. Pneumotoscopy offers an added dimension to this examination. Pneumatic insufflation allows a dynamic assessment of the tympanic membrane and middle ear. Often what appears to be a perforation on otoscopy may well be shown to be a retraction with pneumatic insufflation. In addition, fluid within the middle ear is more apparent with pneumatic insufflation – either because the tympanic membrane demonstrates decreased mobility, or a fluid level and air bubbles are better identified.

Pneumatic otoscopy is accomplished by a technique requiring the use of a speculum large enough to fit snugly into the ear canal. This establishes a closed air chamber between the canal and the otoscope head. The bulb of the pneumatic attachment is held in the palm of the hand retracting the pinna (*Figure 2, 3*). The pressure of the air within the canal can then be increased by gently squeezing the bulb of the pneumatic attachment. Pneumatic otoscopy should be performed gently, and the patient warned beforehand that a feeling of pressure in the ear will be experienced. When the tympanic membrane and the pressure within the middle ear are normal, the tympanic membrane will show a crisp

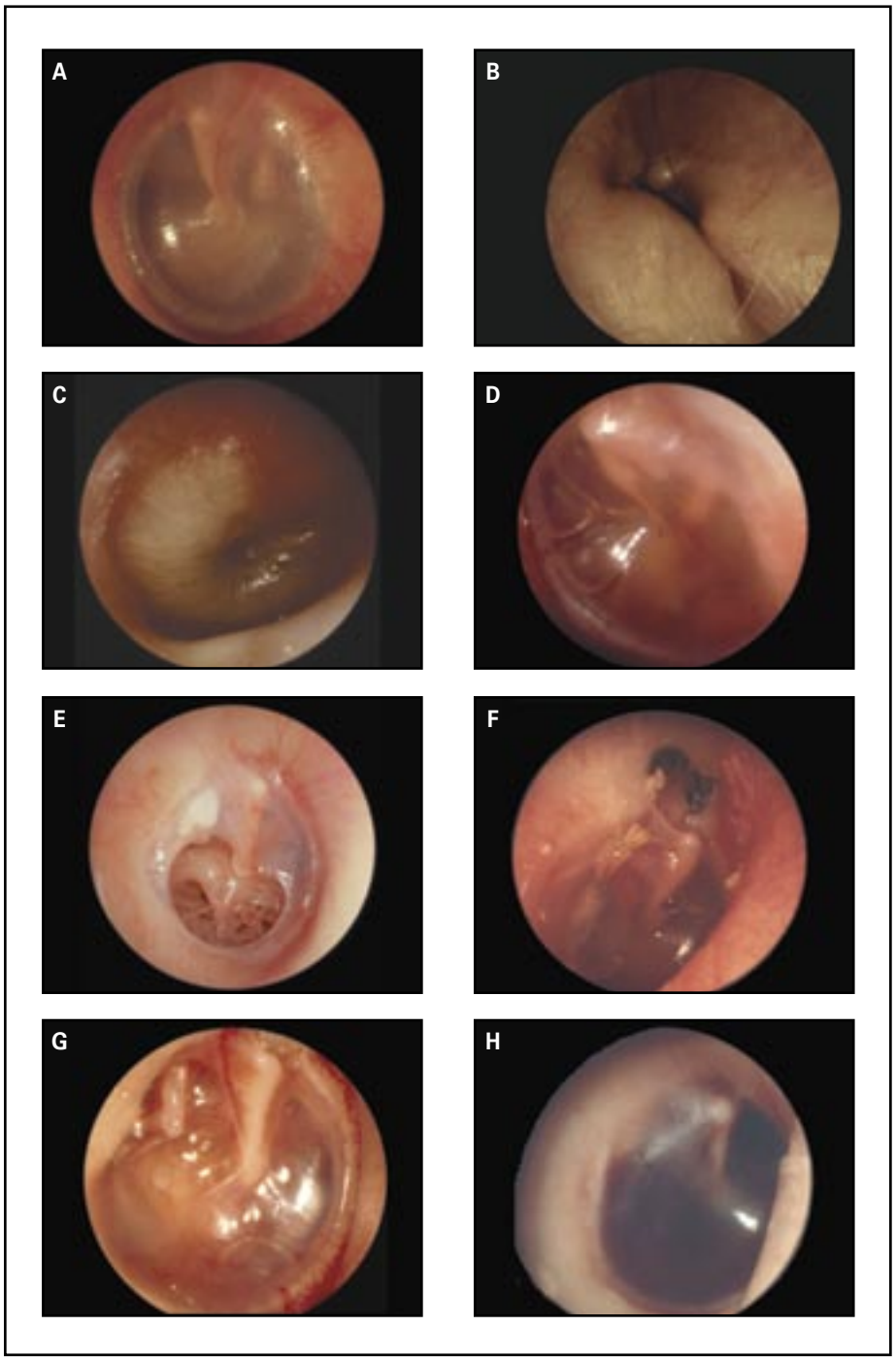

Figure 4. Common otoscopic appearances
A. Normal tympanic membrane
B. Occluding exostoses
C. Acute otitis media
D. Serous middle ear fluid
E. Tympanic membrane perforation
F. Attic cholesteatoma
G. Retracted tympanic membrane
H. Blood stained middle ear fluid due to barotrauma

inward movement when the pressure is increased by squeezing the bulb. Once the bulb is released and the pressure returns to normal, the tympanic membrane will snap outward.

When the air pressure within the middle ear is negative due to eustachian tube dysfunction, the tympanic membrane will move with less excursion and in a more sluggish fashion. Fluid in the middle ear results in minimal or no movement of the tympanic membrane. In this case, the only observable movement may be a slight outward displacement of the outer cartilaginous external canal.

Figure 5. Otoscopy in children is performed in the comfort of the parent's firm grasp

Figure 6. Using a vorascope to examine the ear

Figure 7. Using a microscope to examine the ear

Cleaning the ear

Cerumen removal

The ear canal may be occluded by wax and debris, obscuring a complete view of the tympanic membrane. This wax on occasions needs to be removed in order to completely visualise the entire tympanic membrane thereby enabling a proper otoscopic examination to be accomplished.

Ear wax, or cerumen, is an accumulation of sebum and secretions of the ceruminous glands mixed with desquamated keratin. Cerumen is continuously produced by modified sweat glands located in the hair bearing outer third of the ear canal. Cerumen lubricates the external ear, and also protects the ear by virtue of antibacterial properties and by physically trapping debris. The ear is a self cleaning organ as epithelial migration gradually moves cerumen toward the external auditory meatus. However, patients commonly perceive wax as an indicator of poor hygiene rather than a vital component in the function of a healthy ear.

Cerumen can be safely removed by syringing or instrumentation under direct vision. When the introduction of water into the ear canal is contraindicated, instrumentation is the preferred method of cleaning the ear (*Table 2*).

Figure 8. Jobson-Horne wax curette: the most versatile instrument for cleaning the ear canal (A) Ring curette for wax removal on one end (B) Apply cottonwool to the tip of the other end for cleaning aural discharge

Figure 9. Dental probe tip onto which a wisp of cottonwool is attached for cleaning of the ear canal

Ear syringing

Although a commonly performed procedure, ear syringing has the potential to cause discomfort or even injury to the patient if not carried out with correct instrumentation and technique (*Table 3*).

Wax removal by instrumentation

Firm wax can be removed safely using a wax curette (*Figure 8*) or a dental probe tipped with cottonwool (*Figure 9*). This procedure is performed under direct vision using the largest fitting speculum with adequate illumination provided by a vorascope or microscope. An unobstructed view of the canal is necessary to avoid trauma to the delicate canal wall skin.

In cases in which syringing does not readily dislodge a plug of wax, further attempts at removal are likely to cause unnecessary trauma or inflammation of the outer ear. In this instance, advise the patient to instil a bland ceruminolytic such as olive oil or bicarbonate drops into the ear canal for 5 days before returning.

Cleaning the ear of discharge

If purulent debris is found in the ear canal, a swab may be taken for laboratory culture and sensitivity testing before cleaning the ear. The presence of purulent debris in the canal is a contraindication to aural syringing and hence the canal should be cleaned with a cottonwool tipped probe under direct vision using a vorascope or microscope. Alternatively the patient may be referred to an ENT surgeon for cleaning using suction.

Figure 10. Tuning fork suitable for testing of hearing

Tuning fork tests

The tuning fork serves as an essential tool in the diagnosis of hearing

Figure 11. Assessing air conduction: tuning fork an inch from ear

Figure 12. Assessing bone conduction: tuning fork pressed firmly on the mastoid process

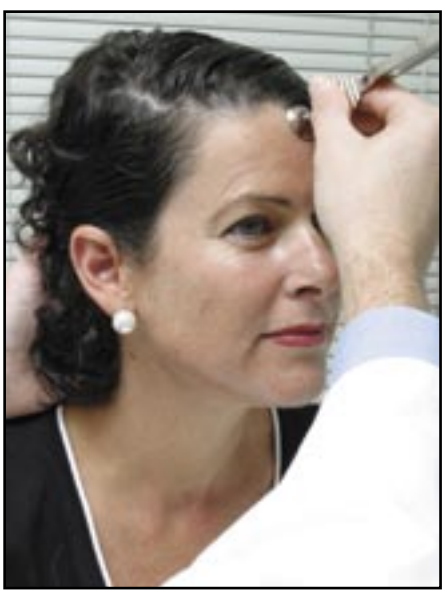

Figure 13. Performing the Weber test: tuning fork is pressed firmly on the patient's forehead

Table 3. Tips for successful ear syringing

- Protect the patient's clothing with a towel or plastic sheet
- Ask the patient to hold a kidney dish underneath the pinna of the ear
- Use water at 37˚C
- Check that the nozzle in firmly screwed secure onto the syringe
- Check that the plunger is well lubricated within the syringe
- Ensure that all air is removed from the syringe before irrigation
- Direct the stream of water along the roof of the canal. This insinuates water between the tympanic membrane and the wax, flushing the wax plug out. Directing water at the wax plug simply pushes it further into the canal
- Stop if the patient complains of pain, dizziness or nausea
- It is advised that the procedure not last longer than 2 minutes
- Following ear syringing, the tympanic membrane frequently appears pink and tympanic blood vessels are dilated

Table 4. Interpretation of tuning fork tests

	Rinne test	Weber test
Normal hearing	Positive (sound perceived louder by air conduction than bone)	Centralising
Left conductive loss	Negative (bone conduction perceived as louder)	Lateralises to left
Left sensorineural loss	Positive or false-negative*	Lateralises to right
Right conductive loss	Negative	Lateralises to right
Right sensorineural loss	Positive or false-negative*	Lateralises to left

* If sensorineural loss is total in the testing ear there may be a false-negative Rinne test in which sound is perceived via bone conduction in the contralateral ear

loss. It allows reliability and accuracy in distinguishing between conductive and sensorineural hearing loss. Tuning fork tests are based on two fundamental principles:

- the inner ear is more sensitive to sound conducted by air than bone, and
- with a pure conductive hearing loss, the affected ear is subject to less environmental sound and hence is more sensitive to bone conducted sound.

The 512Hz tuning fork is the only tuning fork required for the general assessment of hearing. It is recommended that the tuning fork have a wide base to ensure optimal transmission of sound and patient comfort when pressed firmly upon the head (*Figure 10*).

The tines of the tuning fork should be struck against a firm, but elastic mass (eg. a rubber pad, knee, elbow), one-third of the way from the free end in order to minimise distortion and prevent the production of overtones.

The Rinne test

The Rinne test aids in the detection of conductive hearing loss.

Performing the Rinne test

- A vibrating tuning fork is held with its tines perpendicular to the long axis of the external auditory meatus with the closest tine held an inch from the entrance to the canal in order to test air conduction (*Figure 11*)
- The patient is asked if they can hear the sound
- When the sound is no longer heard, the fork is transferred behind the ear with its base pressed firmly against the mastoid

process (*Figure 12*)
- The patient is then asked if the sound 'in front of the ear' (ie. air conduction) or 'behind the ear' (ie. bone conduction) is louder.

Interpreting results (*Table 4*)

Positive Rinne test: if the sound is perceived as louder by air conduction than by bone conduction this indicates:
- no conductive hearing loss.

Negative Rinne test: if the sound is reported louder by bone conduction this identifies:
- conductive hearing loss.
- total sensorineural hearing loss. In this case the sound of the tuning fork is transmitted across the skull via bone conduction and is perceived by the patient's contralateral ear. This is termed a false-negative Rinne test.

The Weber test

The Weber test is used in conjunction with the Rinne test to determine whether unilateral hearing loss is conductive or sensorineural.

Performing the Weber test

- A vibrating tuning fork is placed in the midline of the forehead
- The patient is asked if the sound is heard better on one side or in the middle of the head (*Figure 13*).

Interpreting results (*Table 4*)

A centralising Weber is described if the tone is heard equally in both ears and identifies:
- normal hearing

A lateralising Weber is described when the tone is heard on one side of the head:
- if the tuning fork lateralises to the same side as the poorer hearing ear, the hearing loss is conductive
- if the tuning fork lateralises to the opposite side as the poorer hearing ear, the hearing loss is sensorineural.

Conclusion

While the deeper anatomy of the ear may be relatively inaccessible, illumination and magnification with appropriate instrumentation permits unsurpassed visualisation of these structures. Often this is all that is required to confirm the diagnosis of external and middle ear pathology in clinical practice, and for appropriate treatment to be immediately instituted. The recommended instrumentation and described techniques will serve to make the assessment of the ear even more beneficial and comfortable for the physician and patient alike.

Resource

Hawke M, Keene M, Alberti PW. Clinical otoscopy: an introduction to ear diseases, 2nd ed. London: Churchill Livingstone, 1990.

Conflict of interest: none declared.

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