Chapter 1

The ear: some applied basic science

The pinna

The external ear or pinna is composed of cartilage with closely adherent perichondrium and skin. It is developed from six tubercles of the first branchial arch. Fistulae and accessory auricles result from failure of fusion of these tubercles.

The external auditory meatus or ear canal

The external auditory meatus is about 25 mm in length, has a skeleton of cartilage in its outer third (where it contains hairs and ceruminous or 'wax-producing' glands) and has bone in its inner two-thirds. The skin of the inner part is exceedingly thin, adherent and sensitive. Wax, debris or foreign bodies may lodge in an antero-inferior recess at the medial end of the meatus.

The tympanic membrane or eardrum (Fig. 1.1)

The tympanic membrane is composed of three layers from out to in – skin, fibrous tissue and mucosa. The normal appearance of the membrane is pearly and opaque. When light reflects off the drum it forms a characteristic triangular 'light reflex' due to its concave shape. If you see this 'light reflex', that is good evidence that the drum is normal.

The tympanic cavity or middle ear

Medial to the eardrum, the tympanic cavity is an air-containing space 15 mm high and 15 mm antero-posteriorly, although only 2 mm deep in parts. The middle ear contains the small middle-ear bones the malleus, incus and stapes ('hammer', 'anvil' and 'stirrup') (Figs 1.2 and 1.3). Its medial wall is crowded with structures

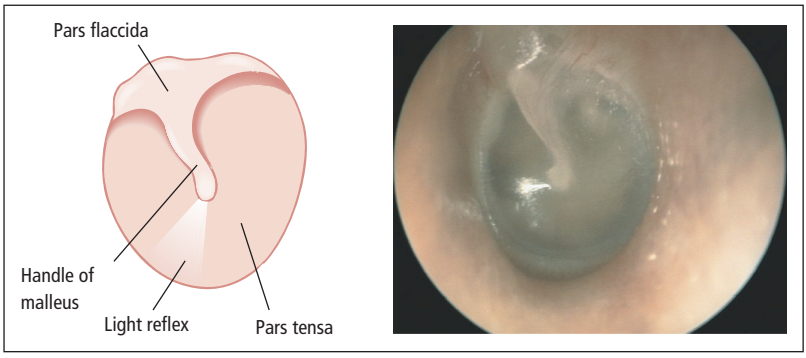

Figure 1.1 The normal tympanic membrane (left). The shape of the incus is visible through the drum at 2 o'clock (courtesy of MPJ Yardley). The 'pars flaccida' in the upper part of the drum is thinner than the 'pars tensa' as the middle fibrous layer is defective.

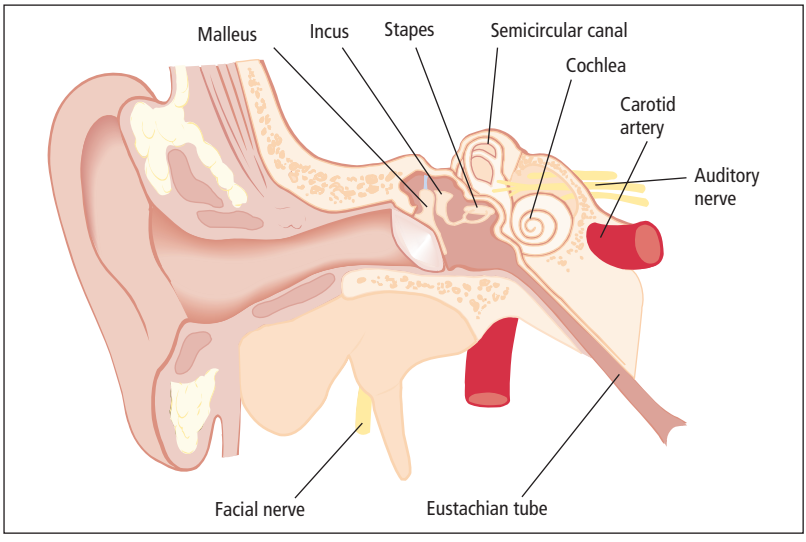

Figure 1.2 Diagram to show the relationship between the external, middle and inner ears.

closely related to one another: the facial nerve, the round and oval windows, the lateral semicircular canal and basal turn of the cochlea.

The Eustachian tube

The Eustachian tube connects the middle-ear cleft with the nasopharynx at the back of the nasal cavity. The tube permits aeration of the middle ear and if it is

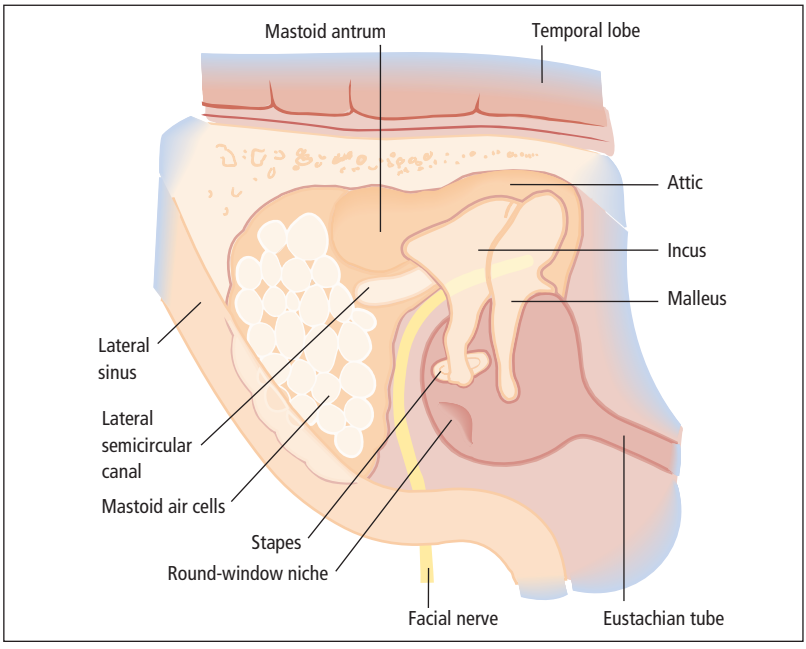

Figure 1.3 Diagram to show the anatomy of the middle ear and mastoid air cells.

obstructed fluid may accumulate in the middle ear causing deafness. The tube is shorter, wider and more horizontal in the infant than in the adult. Secretions or food may enter the tympanic cavity more easily in the supine position particularly during feeding in babies. The tube is normally closed and opens on swallowing because of movement of the muscles of the palate. This movement is impaired in cleft palate children who often develop accumulation of middle-ear fluid.

The inner ear

The inner ear is made up of the cochlea, responsible for hearing and the semicircular canals which house the 'balance organs'. The delicate neuroepithelium is well protected in the dense petrous part of the temporal bone (Figs 1.4 and 1.5).

The facial nerve

The facial nerve is the motor nerve to the muscles of facial expression. Intimately associated with the ear, it is embedded in the temporal bone and passes through

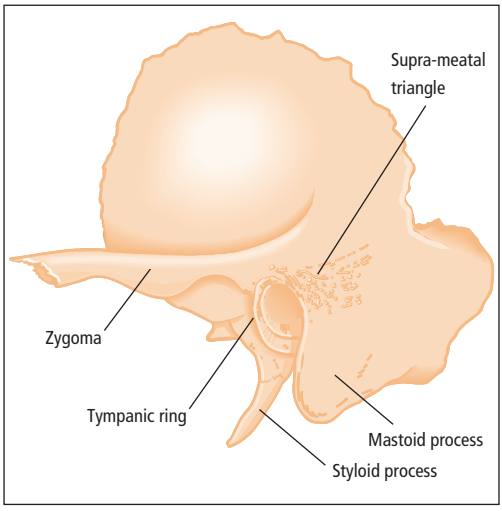

Figure 1.4 The left temporal bone.

Figure 1.5 A preparation showing the bony inner ear of semicircular canals and cochlea (preparation by Mr S. Ell).

the middle ear but exits the skull at the stylomastoid foramen just in front of the mastoid process. In infants, the mastoid process is undeveloped and the nerve is very superficial.

The mastoid cells

The mastoid cells form a honeycomb within the temporal bone, acting as a reservoir of air to limit pressure changes within the middle ear. The extent of

pneumatization is very variable and is usually reduced in chronic middle-ear disease when the mastoid is often said to be 'sclerotic'.

The mechanism of hearing

Sound causes the eardrum to vibrate. This energy is transmitted via the ossicles to the oval window which is in contact with the stapes. A 'travelling wave' is set up in the fluids of the inner ear. Specialized neuroepithelial cells ('hair cells') in the cochlea or inner ear convert this energy to nerve impulses which then travel along the auditory pathway to the cortex where they are recognized as sound. Diseases which interfere with transmission of sound across the 'outer' and 'middle' ear cause 'conductive' deafness, and diseases in the 'inner ear' which interfere with the conversion of this energy to nerve impulses or with the transmission of these nerve impulses cause sensorineural or 'nerve' deafness.

Clinical practice points

- The facial nerve is intimately related to the middle and inner ears. Always check the ear carefully in a patient with facial palsy.
- The middle ear amplifies sound. The inner ear is essential for hearing. Middle-ear disease may cause some degree of deafness but if the inner ear is not functioning the patient will be completely deaf in that ear.