CHAPTER 13

External and middle ear c00013

Eytan A David

b0010 **CORE PROCEDURES**

p0015
- Surgical approaches:
  - u0015 Transcanal
  - u0020 Endaural
  - u0025 Retroauricular
- u0030 Canaloplasty:
  - u0035 Osteoma/exostosis
  - u0040 Middle meatal stenosis
- u0045 Tympanic membrane:
  - u0050 Myringotomy tube
  - u0055 Myringoplasty.
  - u0060 Tympanoplasty: small, medium and large perforations
- u0065 Ossiculoplasty:
  - u0070 Basic situation one: malleus and stapes present, incus missing
  - u0075 Basic situation two: incus and stapes missing; mobile versus fixed footplate
  - u0080 Basic situation three: stapes only – mobile stapes; mobile footplate; fixed footplate
- u0085 Stapedotomy
- u0090 Mastoidectomy: canal wall up versus canal wall down.

s0025 A note on terminology

p0105 Three synonyms are used to describe the cartilaginous and bony tube that connects the external and middle ears: the terms 'external acoustic meatus', 'external auditory meatus' and 'external auditory canal' all appear in approximately equal measure in the anatomical and clinical literature. In the *Terminologia Anatomica* (used by anatomists), the entire tube is called the external acoustic meatus. Clinically, the terms 'external acoustic meatus' (EAM) or 'external auditory/acoustic canal' (EAC) may be used to define the entire tube; alternatively, the term 'meatus' may be confined to the round lateral opening of the EAC. In this chapter and in Chapter 14, the term external auditory canal refers to the entire tube and the term external acoustic meatus is confined to the round lateral opening of the EAC.

s0030 INTRODUCTION

p0110 The primary function of the external and middle ear is to amplify sound. The anatomical structure of the outer ear, the auricle, reflects this primary function by gathering, amplifying and directing sound into the EAC. The EAC is a closed-ended cylinder in which resonances occur at a wavelength that is four times the length of the cylinder. For the EAC, this corresponds to a resonance frequency of 2.6–3 kHz, which contributes a 10 dB gain. The entire external ear produces a broad band 15–20 dB gain between 2 and 5 kHz, which includes the important speech frequencies.

p0115 Sound waves reach the tympanic membrane and are amplified by the ossicular chain, consisting of the malleus, incus and stapes. The middle ear transformer mechanism, formed by the middle and inner layers of the tympanic membrane and ossicles, serves as an impedance matching device. Acoustic energy in air is transferred to the fluid-filled cochlea. Impedance matching is effected by the relative size difference between the tympanic membrane and the stapes footplate. The lower two-thirds of the tympanic membrane, the pars tensa, is the most important area for vibration response to sound waves. The ratio of the vibrating portion of the tympanic membrane to that at the stapes footplate results in a 17 times amplification in sound energy. The lever action of the ossicular chain results in an additional 1.3-fold amplification of sound energy. Smaller amounts of energy transference are effected by the fluid wave created within the cochlea as transmissions are initiated in the oval window and travel to the round window membrane.[1]

p0120 The ear surgeon's primary role is in the extirpation of disease and re-establishment of the natural impedance matching characteristics of the outer and middle ear.

EXTERNAL EAR s0035

SURGICAL SURFACE ANATOMY s0040

p0125 The auricle is composed of elastic cartilage, whereas the cartilaginous portion of the EAC is composed of fibrocartilage. The auricle is attached to the EAC by an extension of cartilage from the meatus and by three ligaments. The anterior ligament is attached to the auricle from the root of the zygoma to the tragus and helical crus; the superior ligament extends from the EAC to the spine of the helix; a posterior ligament extends from the mastoid bone to the posterior portion of the concha. The auricle is attached to underlying periosteum by anterior, superior and posterior auricular muscles.

p0130 The auricle and lateral EAC are perfused by the superficial temporal and posterior auricular arteries. The medial EAC is perfused by the deep auricular artery, a branch of the first portion of the maxillary artery, which enters the EAC at the bony cartilaginous junction and extends branches along the superior bony EAC to supply the tympanic vascular ring: this surgically important portion of the superior posterior EAC is termed the 'vascular strip'. The sensory innervation of the outer ear is variable. The EAC is innervated by branches of the trigeminal, facial, glossopharyngeal and vagus nerves. The auricular conchal bowl and posterior EAC are innervated by branches of the facial, glossopharyngeal and vagus nerves. The numerous sources of sensory innervation explain clinical findings such as the vesicular eruption with facial paralysis caused by herpetic infection of the geniculate ganglion (Ramsay Hunt syndrome) and hypaesthesia of the conchal bowl caused by facial nerve compression from a cerebellopontine angle mass (Hitselberger's sign)

p0135 The lateral third of the EAC is cartilaginous except in its superior border, where dense fibrous tissue attaches it to the squamous portion of the temporal bone. This superior defect, the incisura, is the surgical landmark for the endaural surgical approach to the EAC and middle ear. The medial two-thirds of the EAC are composed of a complete cylinder of bone lined only with periosteum and skin, with no intervening subcutaneous tissue. The anterior and inferior walls are composed of the tympanic portion of the temporal bone, and the superior and posterior walls are formed by the squamous and mastoid portions of the temporal bone. The salient surgical landmark, the tympanomastoid suture line, runs along the posterior inferior portion of the EAC and is evident when elevating a tympanomeatal flap. The surgical boundaries of the EAC are demarcated anteriorly by the mandibular fossa; inferiorly by the parotid gland; superiorly by the epitympanic recess (medially) and the cranial cavity (laterally); and posteriorly by the mastoid bone, forming the posterior wall.

EXTERNAL EAR CORE SURGICAL PROCEDURES s0045

Local anaesthesia s0050

p0140 Infiltration with local anaesthesia is useful in intraoperative vasoconstriction and managing postoperative pain. One per cent lidocaine and 1 : 100,000 parts adrenaline (epinephrine) is routinely used to inject the EAC in quadratic fashion, as well as the incisura for transcanal and endaural approaches. Preoperative antiseptic cleansing of injection sites is useful in decreasing skin flora. Comprehensive surgical site preparation is undertaken while the vasoconstrictive effects of the local infiltration are taking effect. The use of a tuberculin (TB) syringe and 25-gauge 38 mm needle is favoured. Haemostasis and the establishment of a 'cadaveric' appearance to the EAC following injection are important in maintaining haemostasis in a microscopic surgical

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