



A GUIDE TO TEMPORAL BONE DISSECTION

MARCUS ATLAS

IN COLLABORATION WITH
ROBERT EISENBERG



Marcus D. Atlas AM, MBBS, FRACS

Professor of Otolaryngology
Curtin Medical School, Curtin University
Ear Science Centre, The University of Western Australia
Director, Ear Science Institute Australia
Perth, Western Australia

Robert Eisenberg MBBS, FRACS

Consultant Otolaryngologist
Newcastle, Australia

All rights reserved. No part of this publication may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanical methods, without the prior written permission of the publisher, except in the case of brief quotations embodied in critical reviews and certain other non-commercial uses permitted by copyright law. For permission requests, contact Ear Science Institute Australia.

4th Edition, 2023

Ear Science Institute Australia

www.earscience.org.au

TABLE OF CONTENTS

Page title	Number
Preface	2
Surface Topography	3
Canalplasty	4 - 5
Cortical Mastoidectomy	6 - 10
Cortical Mastoidectomy: Facial Nerve Exposure	11
Intact Canal Wall Mastoidectomy	12- 14
Modified Radical Mastoidectomy	15 - 18
Subtotal Petrosectomy	19
Cochlea	20
Ossicular Chain Reconstruction	21 - 23
Endolymphatic Sac Surgery	24 - 25
Translabyrinthine Approach	26 - 27
Translabryinthine Approach: Labyrinthectomy	28 - 31
Translabyrinthine Approach: Internal Auditory Canal	32 - 36
Middle Fossa Approach	37 - 41

PREFACE

This is the fourth edition of A Guide to Temporal Bone Surgery. The first edition was widely used by budding otolaryngologists as well as experienced ear surgeons. The second edition utilised the same format but with additional sections dealing with cochlear surgery as well as the middle fossa approach to the internal auditory meatus and posterior fossa. These exposures are now part of everyday temporal bone surgery. This new edition is solely electronic, with the text available online as a PDF along with the accompanying videos that were previously only available on DVDs.

Successful surgery of the temporal bone requires an understanding of the microscopic anatomy and regular practice of the various operative techniques. A structured program utilising this guide, video demonstrations and regular cadaver dissection is the key to appropriate ear surgery. This new edition has been made possible by the Ear Science Institute Australia, a centre of excellence where researchers and surgeons work to investigate new treatments for patients with ear and hearing disorders. The first and second editions of this book would not have been possible without the help of Dr Robert Eisenberg, who is now an accomplished otolaryngologist in Sydney. We again worked closely together despite my move to Western Australia in 2000 where I accepted the Foundation Chair in Otolaryngology.

I appreciate the assistance of two former Fellows in ear and skull base surgery, Dr Peter O'Sullivan and Dr Anirvan Banerjee, as well as Dr Robert Eikelboom, PhD. I remain grateful to Bruce Turnbull, Christine Morgan and Cate Dart who were involved in the first edition. This edition would not have been possible without Billy Chan and Chris Northcott. Finally, my deepest thanks to those closest to me for their patience and tolerance.

Professor Marcus Atlas AM
Director, Ear Science Institute Australia

It is with pleasure that I pen this preface for this edition. The dissections, preparations and research I performed for the first edition, whilst an otolaryngology registrar, gave me invaluable experience. In the same way I feel any trainee, or experienced surgeon, can benefit from methodically working their way through the dissections in this book.

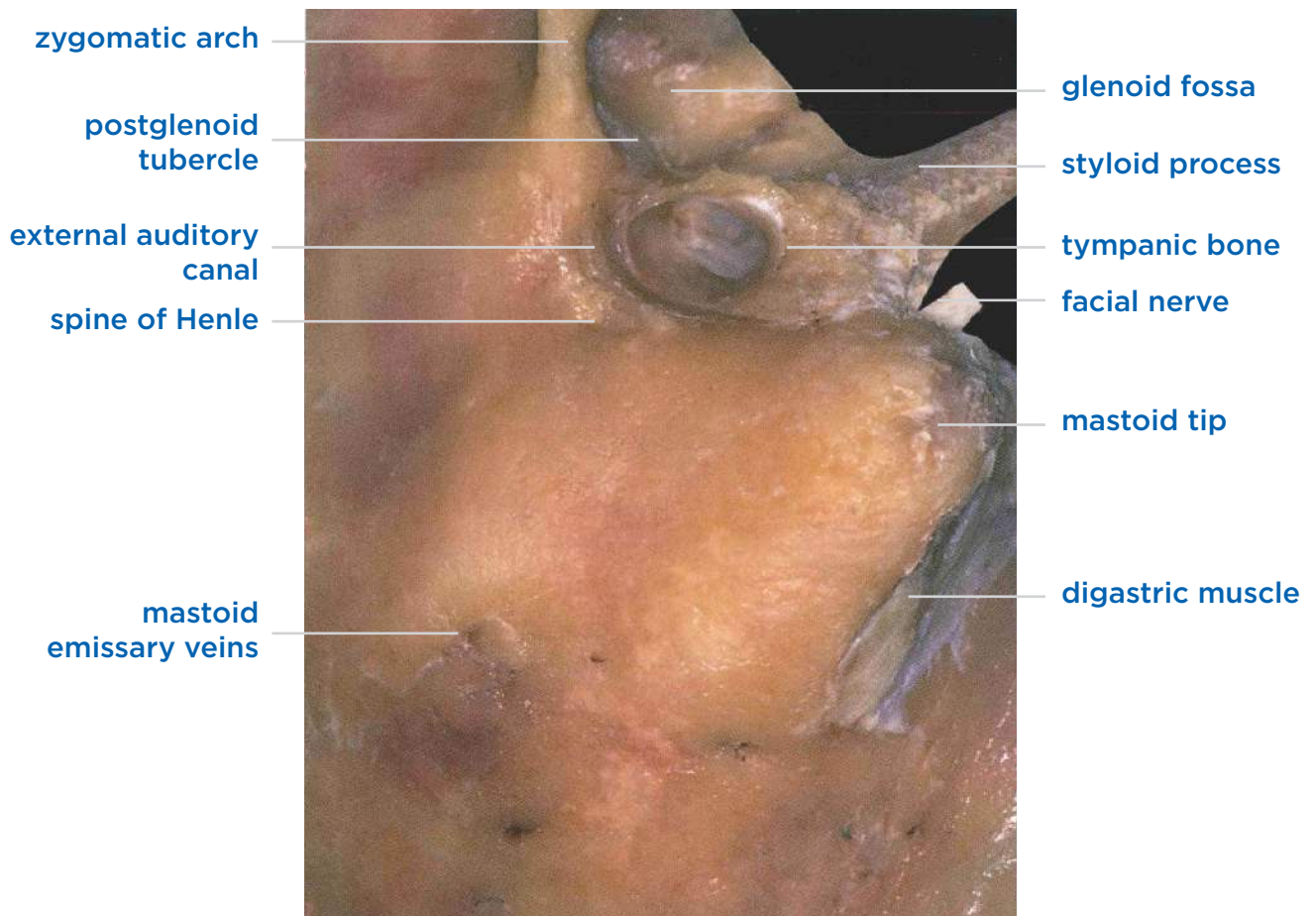
Naturally, Professor Atlas' guidance determined the contents and format of this book based on his many years working in the St Vincent's Hospital Otology and Skull Base Unit. Once again, his clinical expertise has brought this second edition up to the present with the addition of sections on the cochlea and the middle fossa approach. I look forward to continuing our productive and enjoyable collaboration.

Much of the value of this workbook derives from the quality of the images, which are a tribute to the photography of Bruce Turnbull. Many thanks must go to the sponsors and contributors, and last but not least to the forbearance of my wife Melita and daughter Khira.

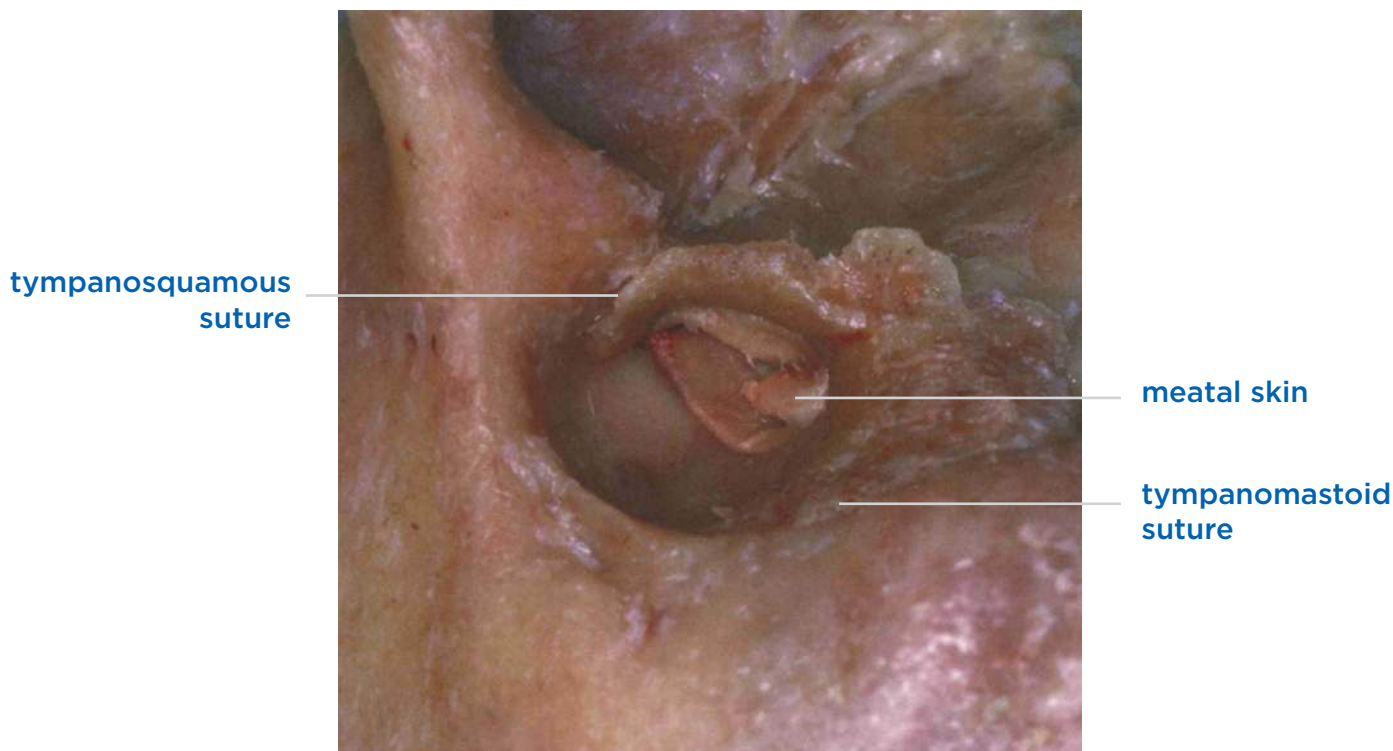
Robert Eisenberg
Otolaryngologist - Head and Neck Surgeon



SURFACE TOPOGRAPHY



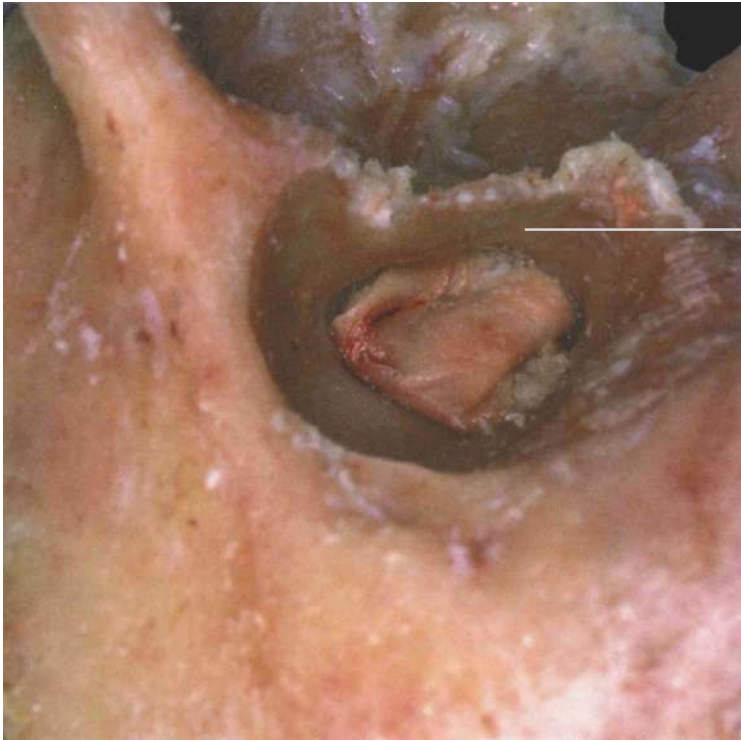
CANALPLASTY



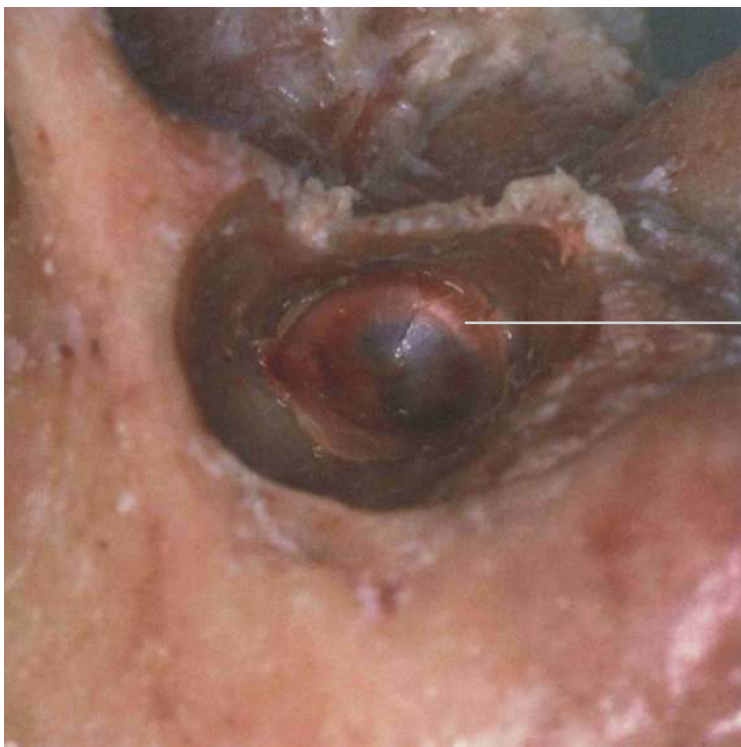
Canalplasty, or enlargement of the external auditory canal, is a key step when performing tympanoplasty and intact canal wall mastoid surgery, as well as treating exostoses and external canal stenosis. The aim of canalplasty is to provide complete exposure of the tympanic membrane and thereby allow accurate and successful myringoplasty, especially when the perforation involves the anterior half of the drum. The widened external auditory canal also provides exposure of the middle ear for ossiculoplasty.

- The meatal skin is elevated to expose the bony external auditory canal.
- Elevation of the meatal skin is carried out carefully and protected with silastic to avoid skin loss.
- The lateral aspect of the canal is enlarged and then the prominent bone of the anterior and inferior walls is removed.
- Dissection of the anterior canal wall is undertaken superiorly and inferiorly. Bone is then removed over the temporomandibular joint area.
- The bone over the blue-coloured temporomandibular joint is carefully preserved to avoid entering the joint capsule.
- All overhanging bone of the canal is removed to reveal the annulus.
- The entire annulus is exposed in one position of the microscope.

CANALPLASTY



bone overlying
temporomandibular
joint



tympanic annulus
(meatal skin removed
to show tympanic
membrane)

- Removal of postero-inferior bone near the annulus places the vertical segment of the facial nerve at risk.
- The lateral process of the malleus is at risk during superior canal dissection.

CORTICAL MASTOIDECTOMY

Cortical mastoidectomy is the preparatory stage of many otological procedures and complex skull base surgery. The procedure of cortical mastoidectomy is also used in the management of acute mastoiditis or idiopathic haemotympanum.

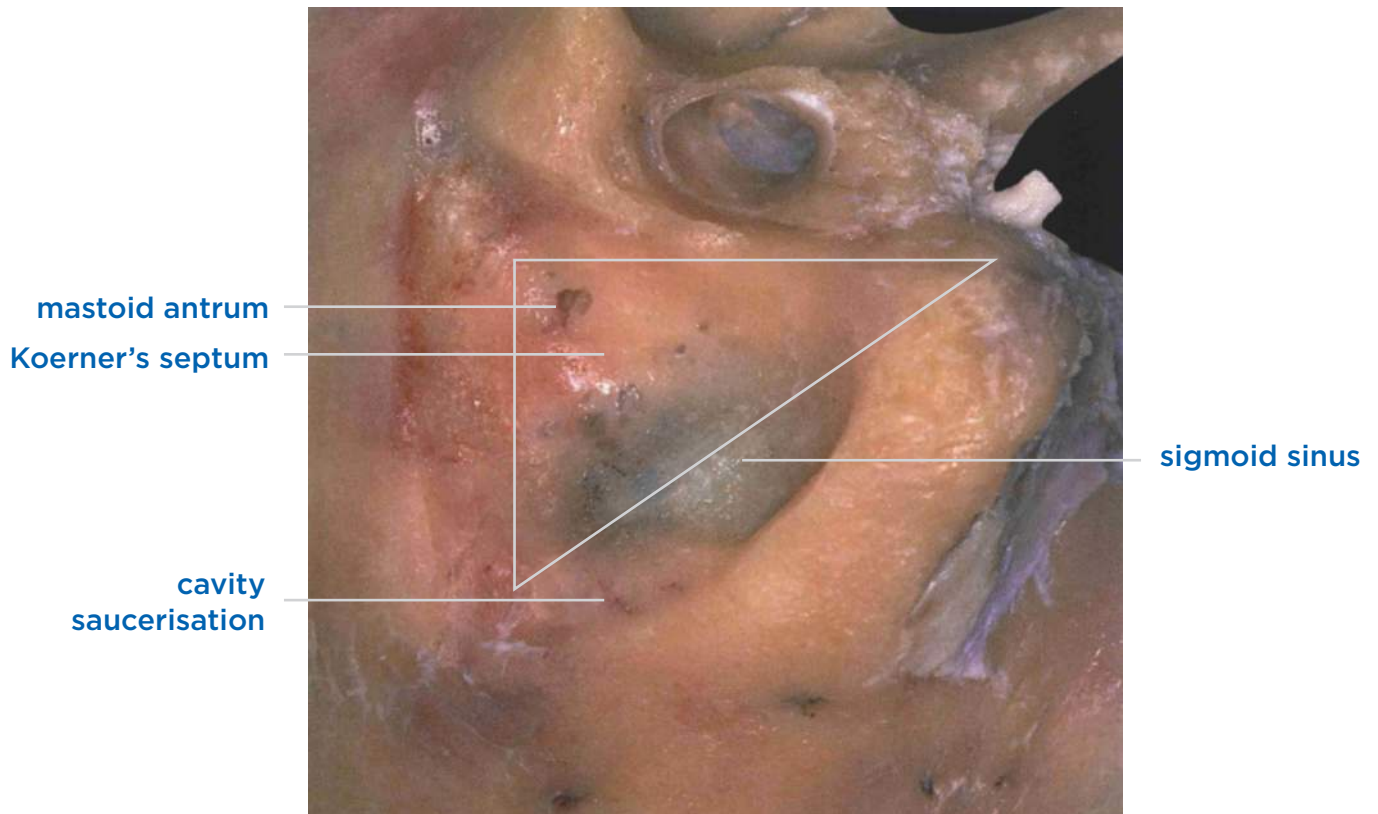
The principal of wide exposure of bone over the middle fossa-dura, sigmoid sinus and mastoid tip will lead to a correctly formed cortical mastoidectomy.

- The mastoidectomy begins with the formation of a triangular opening over the mastoid cortex.

The boundaries of the triangle are:

- a. The temporal line providing the external landmark for the middle fossa-dura. This line is a ridge extending posteriorly from the superior border of the zygomatic arch.
 - b. A line along the suspected position of the sigmoid sinus.
 - c. A vertical line posterior to the external auditory canal.
- The mastoid cortex is then more extensively removed to expose the underlying bone covering the middle fossa dura and sigmoid sinus. Wide removal of bone with large burrs prevents injury to the underlying structures.
 - ‘Saucerisation’ of the cortical mastoidectomy aims to remove the mastoid cortex extensively before deeper dissection and to provide better exposure. Saucerisation allows better soft tissue filling following modified radical mastoidectomy.
 - Inadequate removal of bone is the more common problem during mastoidectomy.

CORTICAL MASTOIDECTOMY



- Koerner's septum represents a portion of the petrosquamous suture line and is a layer of bone that separates the superficial mastoid air cells from the deeper air cells and antrum.
- The septum is initially removed near the middle fossa dura to expose the antrum.

CORTICAL MASTOIDECTOMY



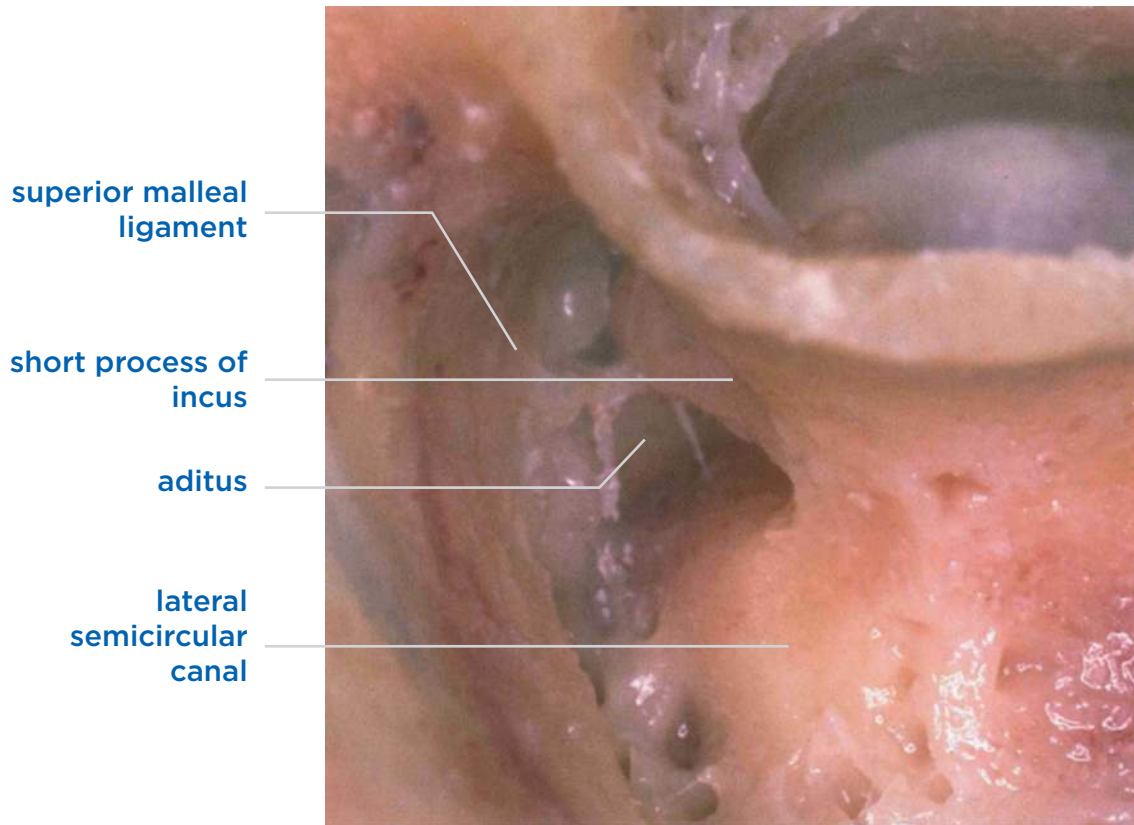
- The cavity is widely enlarged and saucerised, with exposure of the bone over the middle fossa dura, sigmoid sinus and sinodural angle.
- The posterior canal wall should not be removed or excessively thinned as this may lead to a fistula into the mastoid cavity or to avascular necrosis of bone.
- Further removal of bone reveals the antrum.
- Exposure of the tegmen bone covering the middle fossa dura avoids an inferior dissection with consequent damage to the facial nerve and lateral semicircular canal.

CORTICAL MASTOIDECTOMY



- The bone over the middle fossa dura and sigmoid sinus is skeletonised using diamond burrs. The structures can be seen clearly through the transparent bone.
- The tip of the incus and lateral semicircular canal are found within the antrum and are carefully preserved.
- The digastric ridge and stylomastoid periosteum are exposed. These structures provide important landmarks for the facial nerve and facilitate mastoid tip removal during modified radical mastoidectomy.
- The air cells are removed to clearly expose the lateral semicircular canal and then the antrum is opened anteriorly without disrupting the tip of the incus.
- The retrofacial air cells are also dissected in preparation for facial nerve exposure.

CORTICAL MASTOIDECTOMY



- The epitympanum is exposed from the antrum in an anterior direction. Drilling extends into the root of the zygoma to allow exposure of the anterior attic.
- The superior wall of the external canal is carefully preserved.
- The lateral wall of the attic must be dissected to expose the epitympanum correctly.
- The incus and malleus head are exposed.

CORTICAL MASTOIDECTOMY: FACIAL NERVE EXPOSURE



The identification and exposure of the facial nerve establishes the principal landmark of safe temporal bone surgery.

- The facial nerve is identified by removal of posterior canal wall bone, from lateral to medial, parallel to the course of the nerve. Bone is removed initially with a cutting burr utilising copious irrigation.
- Useful landmarks for the mastoid segment of the facial nerve are the digastric ridge, stylomastoid periosteum, lateral semicircular canal and tip of incus.
- Care is taken not to injure the chorda tympani nerve and annulus and not to perforate the posterior canal wall.
- The nerve is skeletonised with a diamond burr leaving only a thin layer of bone covering the epineurium.
- The ampulla of posterior semicircular canal is found medial to the mastoid segment of the facial nerve, adjacent to the retrofacial air cell tract (see page 16).

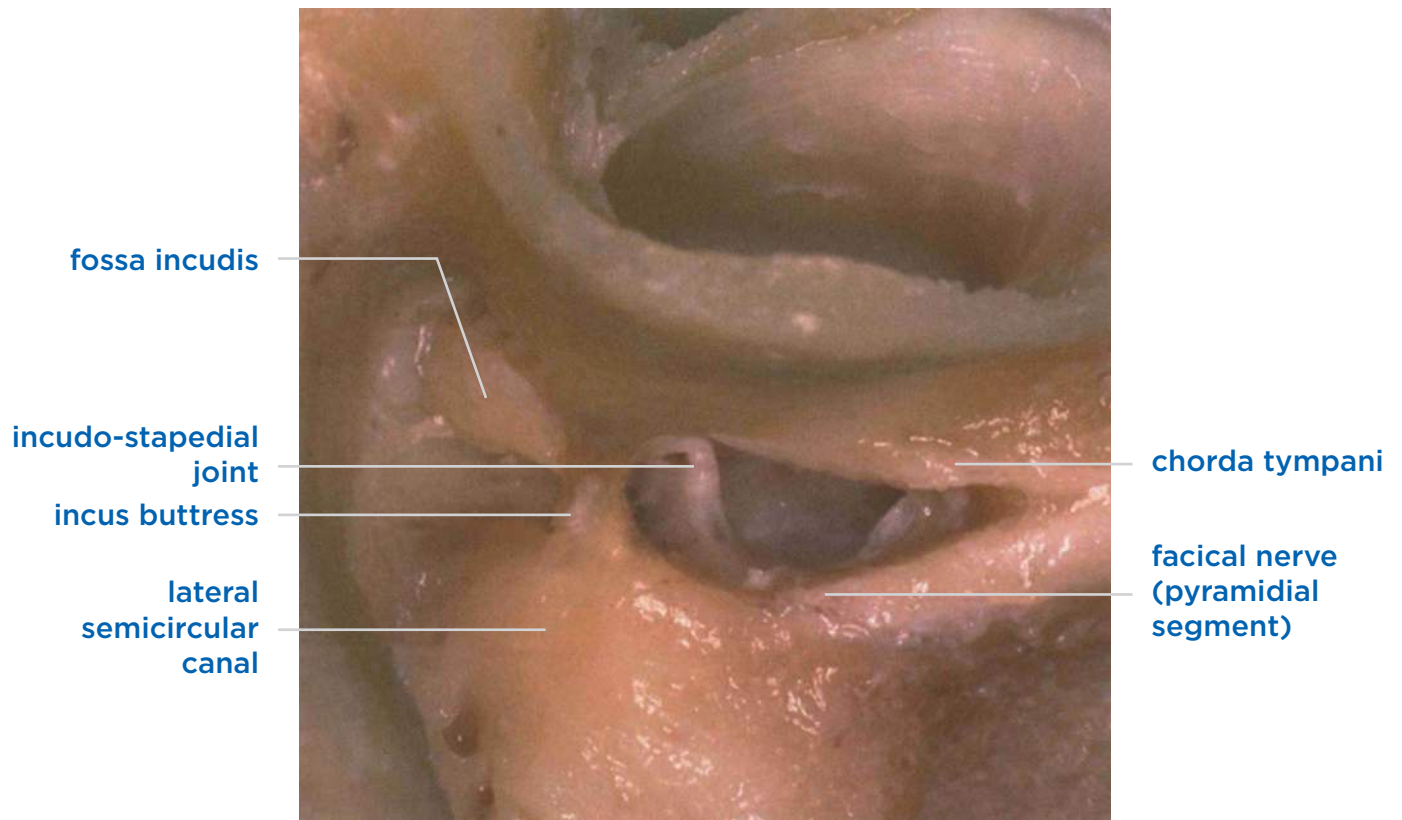
INTACT CANAL WALL MASTOIDECTOMY

Intact canal wall mastoidectomy (combined approach tympanoplasty or canal wall-up mastoid surgery) is most commonly used in surgery of chronic suppurative otitis media, including cholesteatoma and tubo-tympanic type disease. The intact canal wall mastoid approach provides the exposure for cochlear implantation and facial nerve decompression. An extended facial recess dissection is utilised in the removal of larger glomus tympanicum tumours.

The major aims of the surgical management of cholesteatoma are the removal of disease, the creation of a dry ear, and the reconstruction of the middle ear sound conduction system. The technique should prevent recurrent cholesteatoma. Intact canal wall mastoidectomy aims to combine a transcanal and mastoid approach to remove cholesteatoma without removal of the external canal. Certain areas of the tympanomastoid space may be inaccessible, such as the sinus tympani or anterior supralabyrinthine air cells. Intact canal wall mastoidectomy is, therefore, best suited to the management of cholesteatoma in a well-pneumatised mastoid.

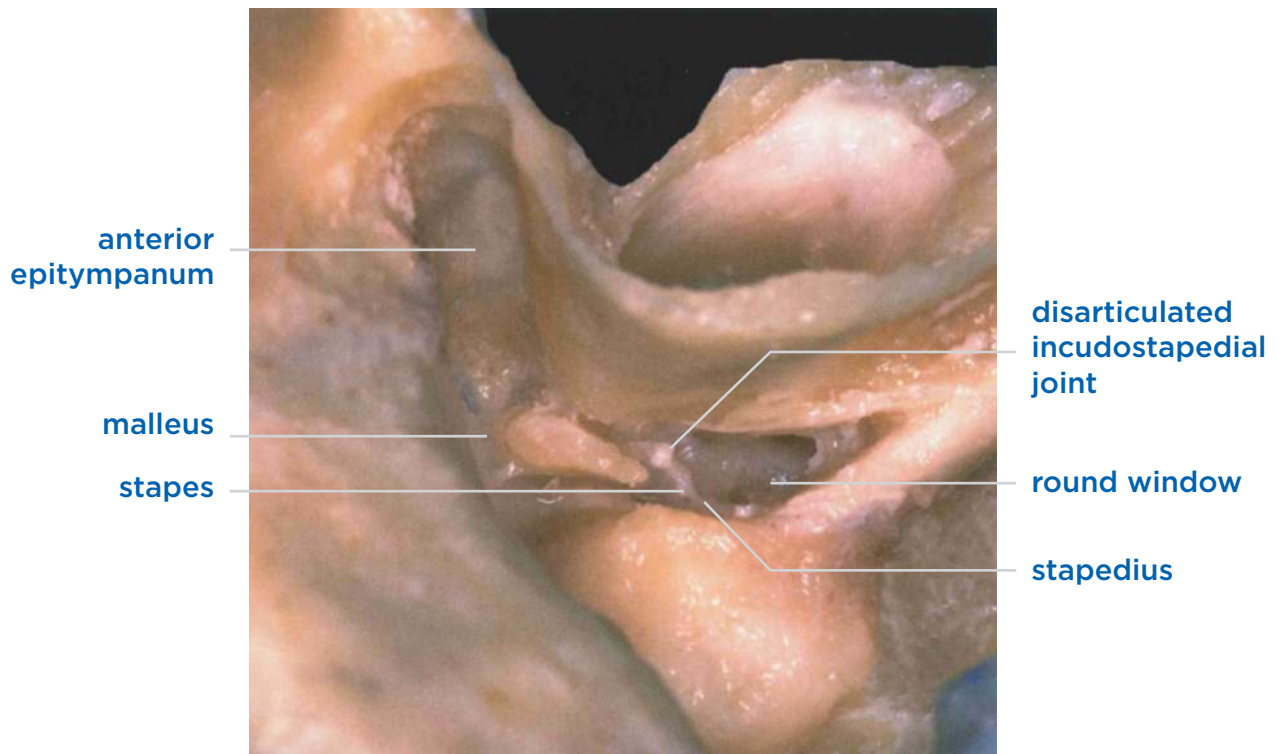
- The posterior tympanotomy or dissection of the facial recess is a key step in intact canal wall mastoidectomy. The boundaries of the facial recess are the upper half of the mastoid segment of the facial nerve, the chorda tympani nerve and the fossa incudis.
- The facial nerve is identified in the mastoid segment and the chorda tympani nerve is identified coursing laterally and anteriorly through the posterior canal wall into the middle ear. Careful preservation of the chorda prevents damage to the annulus and tympanic membrane.
- The facial recess cells between the chorda tympani and the facial nerve are dissected after exposure of the upper half of the mastoid segment of the nerve. A smaller diamond burr is used. The triangular opening revealing the middle ear is known as the posterior tympanotomy.

INTACT CANAL WALL MASTOIDECTOMY



- The structures of the middle ear can be seen through the facial recess. The lenticular process of the incus, incudostapedial joint and head of the stapes are seen with the attached stapedius tendon.
- Further exposure of the hypotympanum can be gained by sacrifice of the chorda tympani nerve.
- Contact with the ossicular chain by the drill is avoided by preserving the bone of the incus buttress.

INTACT CANAL WALL MASTOIDECTOMY



- The incudostapedial joint has been disarticulated to avoid transmission of drill trauma to the inner ear.
- The incus buttress is removed to expose the body of the incus and head of the malleus.
- The epitympanum is widely opened from posterior to anterior without breaching the superior canal wall or dura.
- The incus and head of the malleus can now be removed to provide access to the anterior epitympanum.
- Complete exposure of the anterior epitympanum requires extensive anterior dissection into the zygomatic root. Adequate removal of bone allows dissection of the supralabyrinthine air cells and supratubal space, but only in a well-pneumatized temporal bone.

MODIFIED RADICAL MASTOIDECTOMY

Modified radical mastoidectomy is commonly used in the management of cholesteatoma. The principal indication for modified radical mastoidectomy is cholesteatoma disease with poor pneumatization of the temporal bone. Other indications include cholesteatoma in an only hearing ear, labyrinthine fistula and recurrent cholesteatoma. Modified radical mastoidectomy techniques may be used with malignant tumours of the external auditory canal and benign tumours of the middle ear. Modified radical mastoidectomy is also referred to as open cavity surgery or canal wall down mastoidectomy.

The important surgical concepts involved in modified radical mastoidectomy are related to complete removal of the air cell tracts and the creation of a well-constructed cavity. The advantage of the following modified radical mastoidectomy technique is the extensive exposure of the tympanomastoid space even in the presence of a poorly pneumatized mastoid.

Preliminary stages of open cavity surgery include those previously described in intact canal wall mastoid surgery.

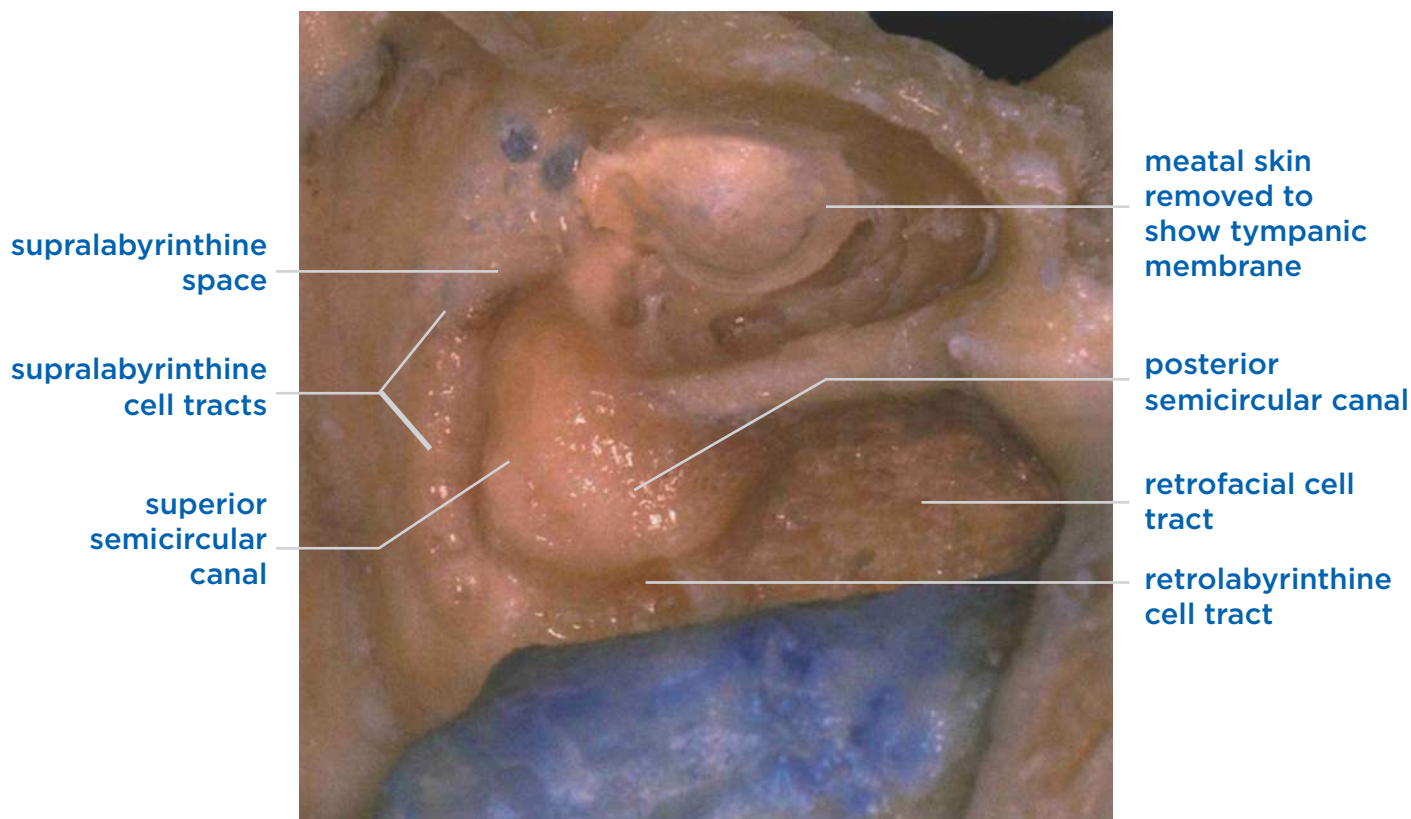
- Cortical mastoidectomy, with wide removal of bone over the middle fossa dura, sigmoid sinus and sinodural angle.
- Digastric ridge and stylomastoid periosteum exposure.
- Epitympanic dissection with exposure of the incus and head of malleus.
- Removal of the sinodural, retrolabyrinthine and retrofacial air cells.

MODIFIED RADICAL MASTOIDECTOMY



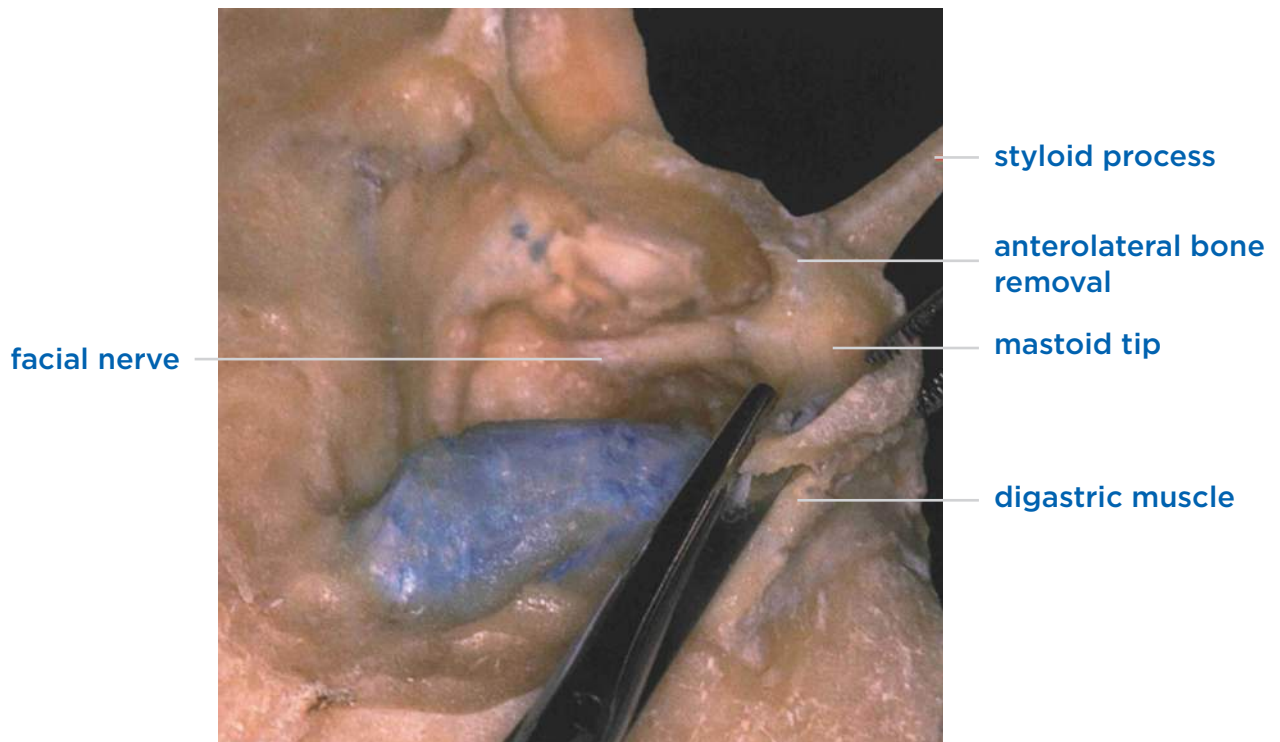
- The incudostapedial joint is disarticulated.
- Posterior canal wall and tympanic bone are lowered to the level of the mastoid portion of the facial nerve, but without exposure of the epineurium.
- The fibrous annulus is exposed, and the tympanic membrane reflected to expose the middle ear.
- Extensive removal of the anterior external canal wall and tympanic bone achieves the correct cavity shape.

MODIFIED RADICAL MASTOIDECTOMY



- The epitympanum is further exposed by lowering the superior canal wall, creating a smooth continuous wall between the anterior epitympanum and anterior canal wall.
- The posterior semicircular canal is carefully identified to allow retrolabyrinthine and retrofacial cell tract removal. The posterior semicircular canal ampulla is very close to the facial nerve.
- Supralabyrinthine cell tract dissection is carried out after dissection into the root of the zygoma.
- The supralabyrinthine space is bounded by the facial nerve (tympanic and labyrinthine segments), superior semicircular canal and middle fossa dura.
- The handle of the malleus and tensor tympani tendon are preserved to improve ossiculoplasty results.

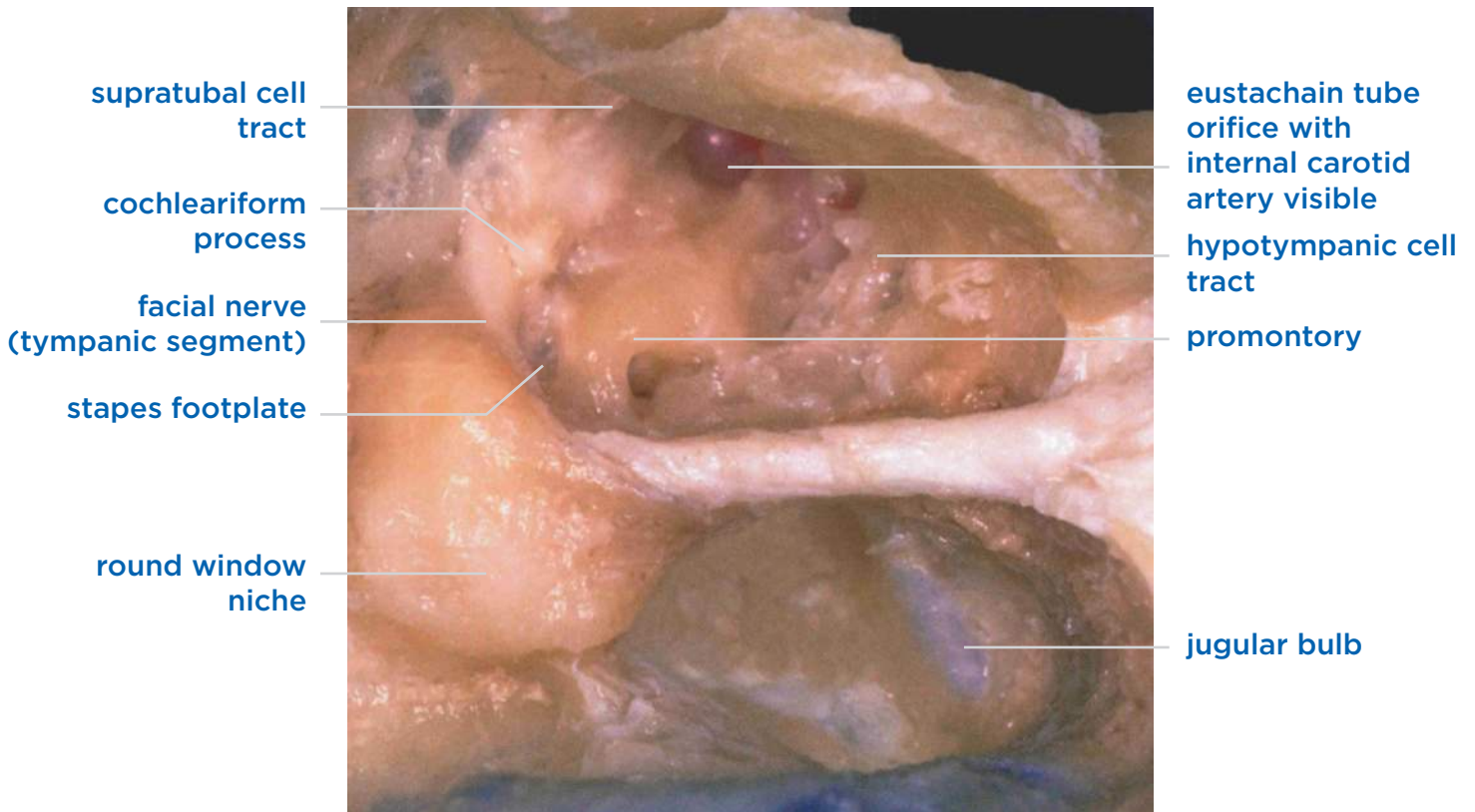
MODIFIED RADICAL MASTOIDECTOMY



The creation of a small, well-formed modified radical mastoidectomy cavity requires removal of the mastoid tip.

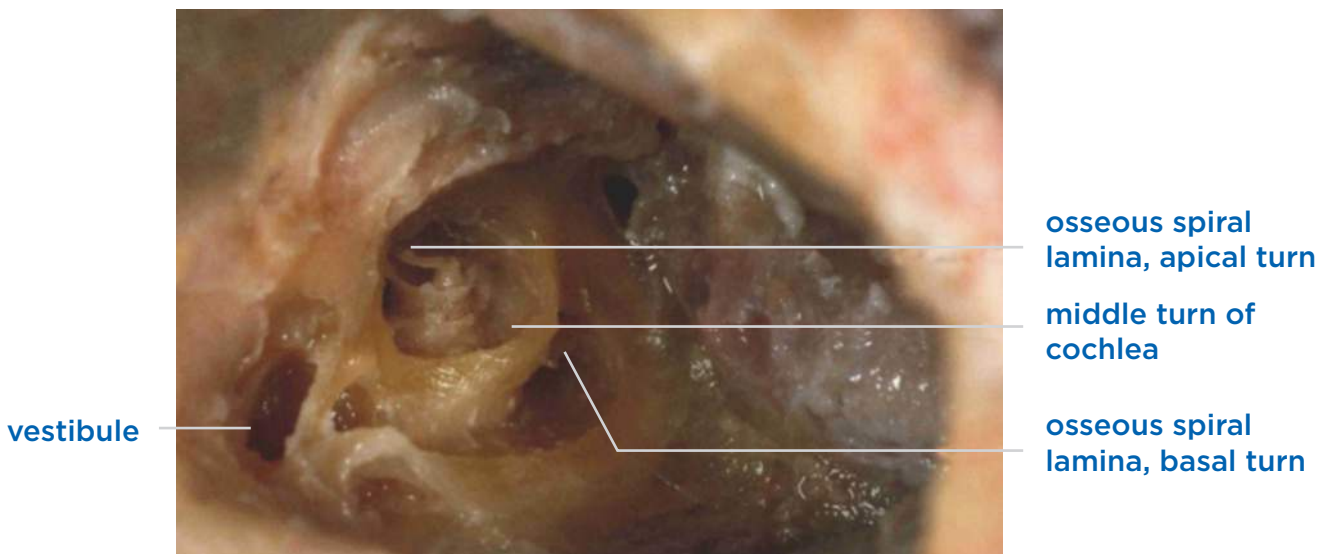
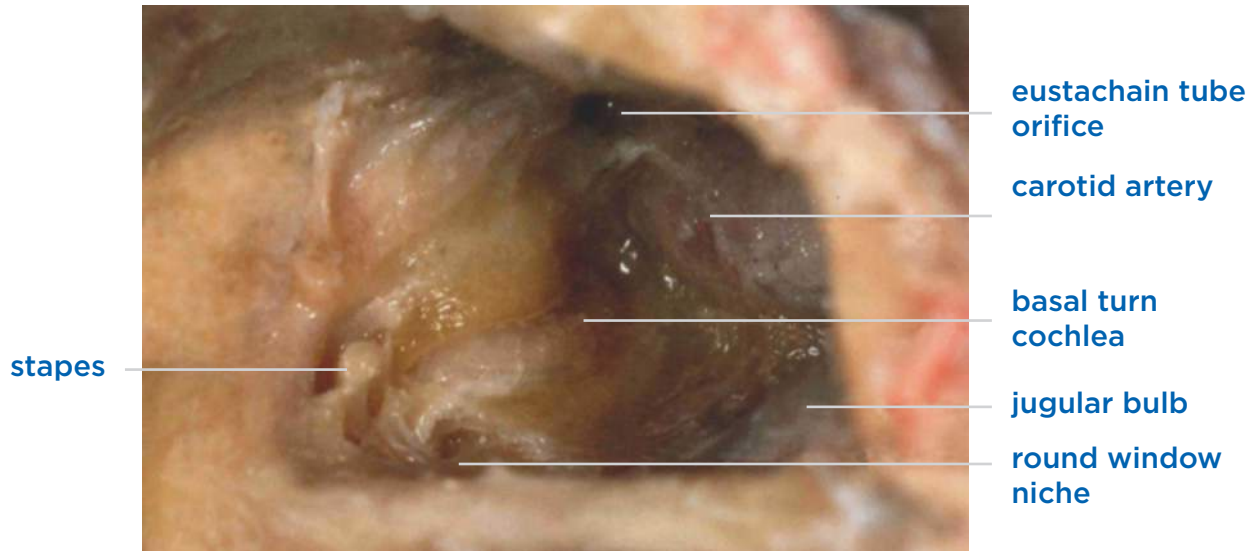
- This facilitates soft tissue obliteration of the posttrial mastoid cavity.
- The digastric muscle is exposed.
- Drilling continues anterior and lateral to the facial nerve, leading to mobilisation of the mastoid tip.
- The mobile mastoid tip is removed by dissection along the lateral border of the digastric muscle, rotating the tip away from the muscle. This plane is lateral to the clearly visible facial nerve.

SUBTOTAL PETROSECTOMY: EUSTACHIAN TUBE & CAROTID ARTERY



- Removal of the tympanic membrane and ossicles reveals the eustachian tube.
- The internal carotid artery is visible medial to the eustachian tube.
- The hypotympanic air cell tract is a potential route to the petrous apex utilising an “infracochlear approach”.
- Subtotal petrosectomy involves transection and closure of the external auditory canal skin (blind sac) with complete mastoidectomy and removal of the tympanic membrane and external canal skin.
- Meticulous dissection of all of the TM and external canal skin is required to prevent later inclusion cholesteatoma.
- Wide field dissection of the middle ear and mastoid air cells tracts.

COCHLEA



- The vertical and horizontal internal carotid arteries are skeletonised without removing the cochlea.
- The promontory bone has been removed to expose the basal turn of the cochlea.
- Each turn of the cochlea is opened to reveal the osseous spiral lamina separating the scala vestibuli and scala tympani.

OSSICULAR CHAIN RECONSTRUCTION

Reconstruction of the eroded, fractured or fixed ossicular chain to restore sound transmission is known as ossicular chain reconstruction or ossiculoplasty. There are three basic situations in ossicular chain reconstruction.

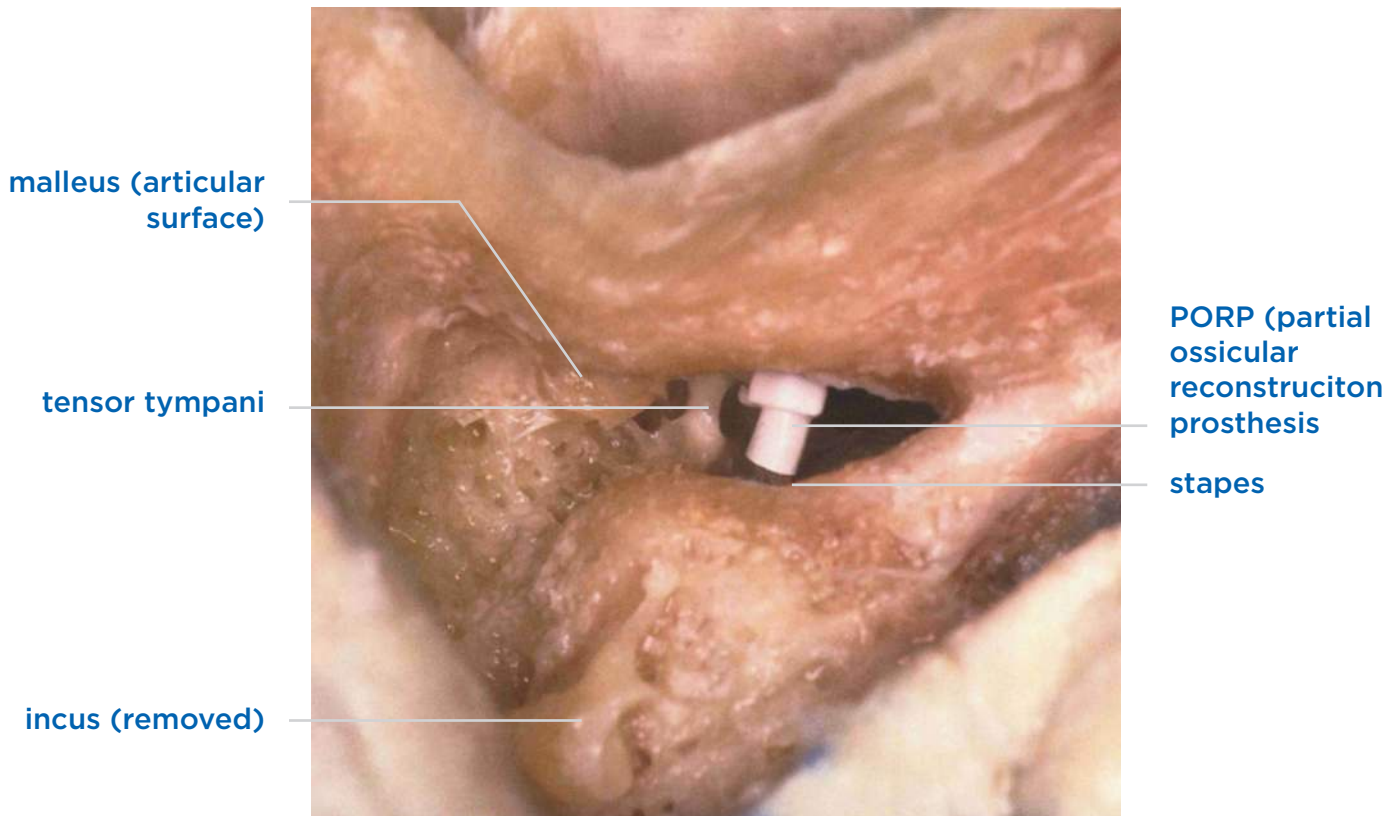
1. The malleus handle and stapes are present, and mobile, but the incus is absent.
2. The malleus handle is present and mobile with an intact footplate but without the stapes suprastructure. The footplate may be mobile or fixed. The incus is missing.
3. The stapes footplate is present, but the malleus and incus are absent.

Restoration of normal hearing following ossiculoplasty is unusual, except following surgery for otosclerosis. The extent of ossicular chain disruption, as described in the three basic situations, has a significant influence on the results of ossicular chain reconstruction.

There are many other variables that may limit the success of ossiculoplasty. These include eustachian tube function, mucosal disease, the state of the tympanic membrane, the cause of ossicular disruption and the material used for reconstruction.

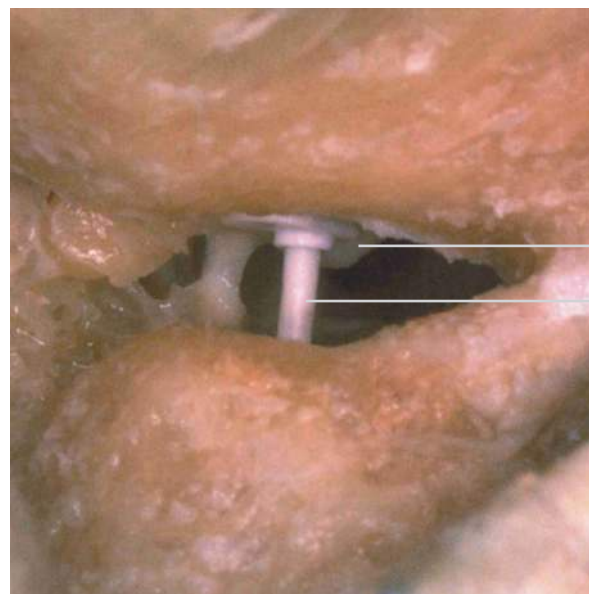
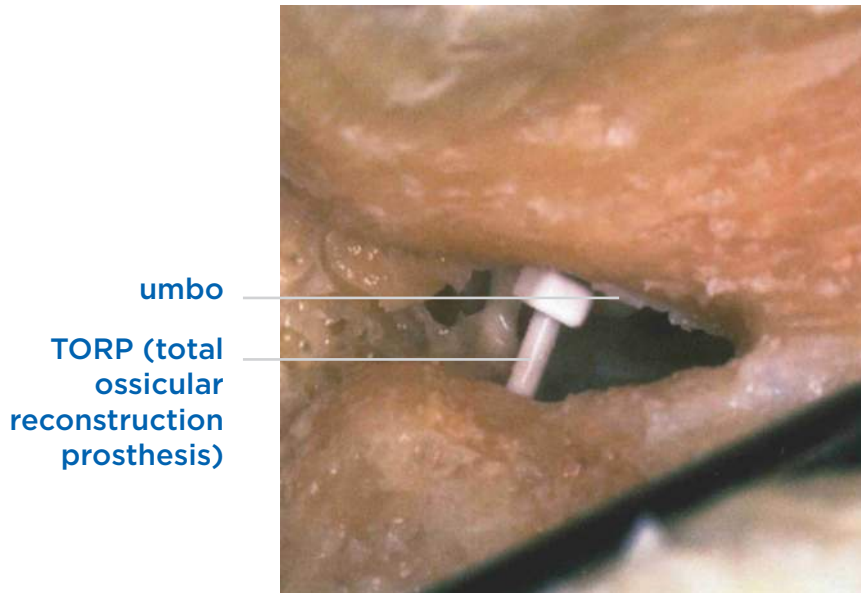
Ossiculoplasty may be achieved using the patient's remodelled tissues such as the incus, other bone or cartilage. Biosynthetic prostheses are also frequently used in ossiculoplasty when autologous material is unavailable or not suitable. The prosthesis used to reconstruct the ossicular chain must be inert and must accommodate placement under tension.

OSSICULAR CHAIN RECONSTRUCTION



- An absent incus is viewed through the facial recess.
- A partial ossicular reconstruction prosthesis has been placed in between the drum (and adjacent malleus) and the mobile stapes. This procedure has been carried out using a transcanal approach but is being viewed through the posterior tympanotomy.
- The tensor tympani has been carefully preserved to provide malleus stability and provides better approximation of the prosthesis.

OSSICULAR CHAIN RECONSTRUCTION



The absence of the stapes suprastructure in association with a mobile footplate is another common situation.

- A total ossicular reconstruction prosthesis has been placed in between the tympanic membrane (and adjacent malleus) connecting to the mobile stapes footplate.
- Different prostheses have alternate designs and utilise differing materials, but results are frequently similar.
- Hearing results appear to be more dependent on the other variables mentioned such as eustachian tube function rather than prosthesis design.

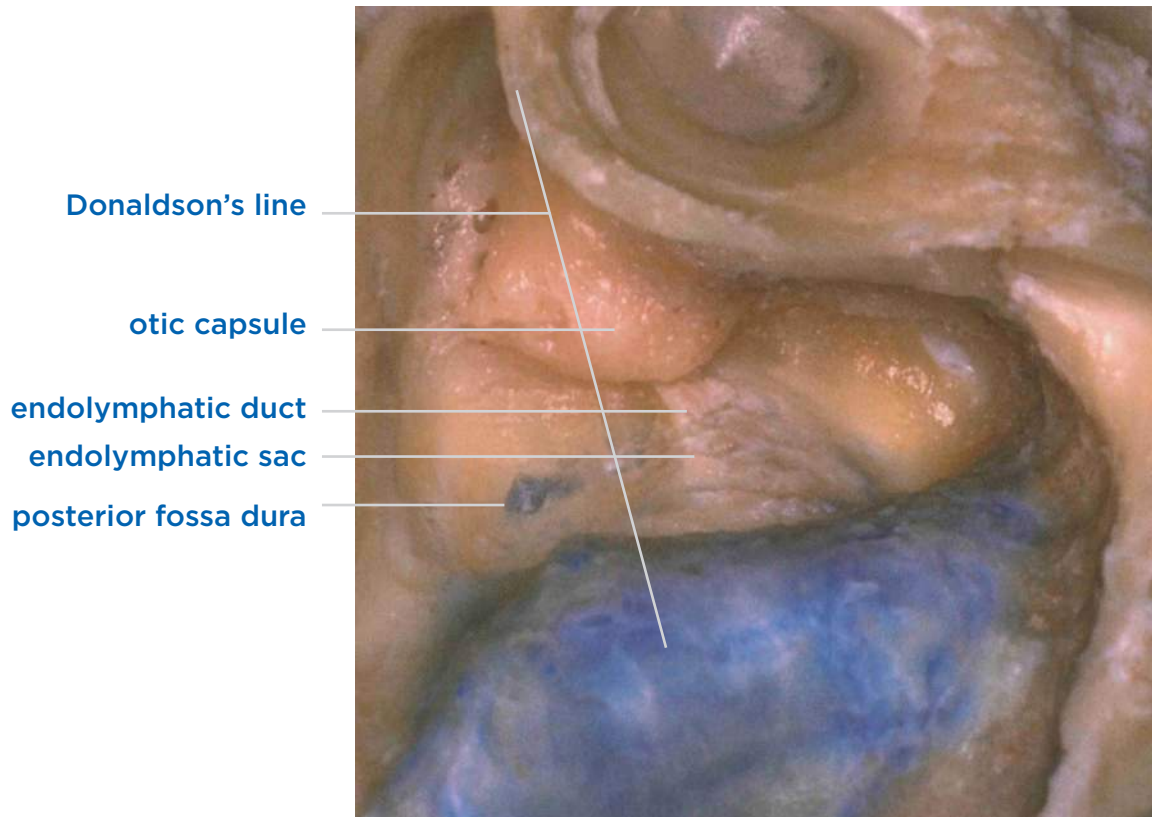
ENDOLYMPHATIC SAC SURGERY

Surgery of the endolymphatic sac is used in the surgical treatment of Meniere's disease. The surgery aims to abolish vertigo and to preserve hearing. This operation has been carried out with many variations, including decompression of the sac or insertion of shunts or tubes into the sac.

The role of the endolymphatic sac in Meniere's disease is still not understood and the mechanism by which this surgery influences the disease is controversial. The endolymphatic sac and part of the endolymphatic duct are exposed after sigmoid sinus and posterior fossa skeletonisation.

- The mastoid segment of the facial nerve, sigmoid sinus and posterior fossa dura are skeletonised.
- Frequently bone must be completely removed from the sigmoid sinus and posterior fossa dura to allow compression and access (see page 27, translabyrinthine approach).
- Compression of the sigmoid sinus provides exposure of the posterior fossa dura and retrolabyrinthine air cell tract.
- The retrolabyrinthine and retrofacial air cells are removed widely to reveal the posterior semicircular canal and jugular bulb.
- The sac is identified by a white "tented" appearance alongside the darker coloured dura. The sac may also be identified by the presence of the endolymphatic duct passing anteriorly, medial to the posterior semicircular canal.

ENDOLYMPHATIC SAC SURGERY



- Donaldson's line is an imaginary line extending posteriorly from the plane of the lateral semicircular canal. It often intersects with the superior border of the endolymphatic sac.
- The endolymphatic sac may be decompressed, or various shunts or tubes may be inserted into the lumen.

TRANSLABYRINTHINE APPROACH

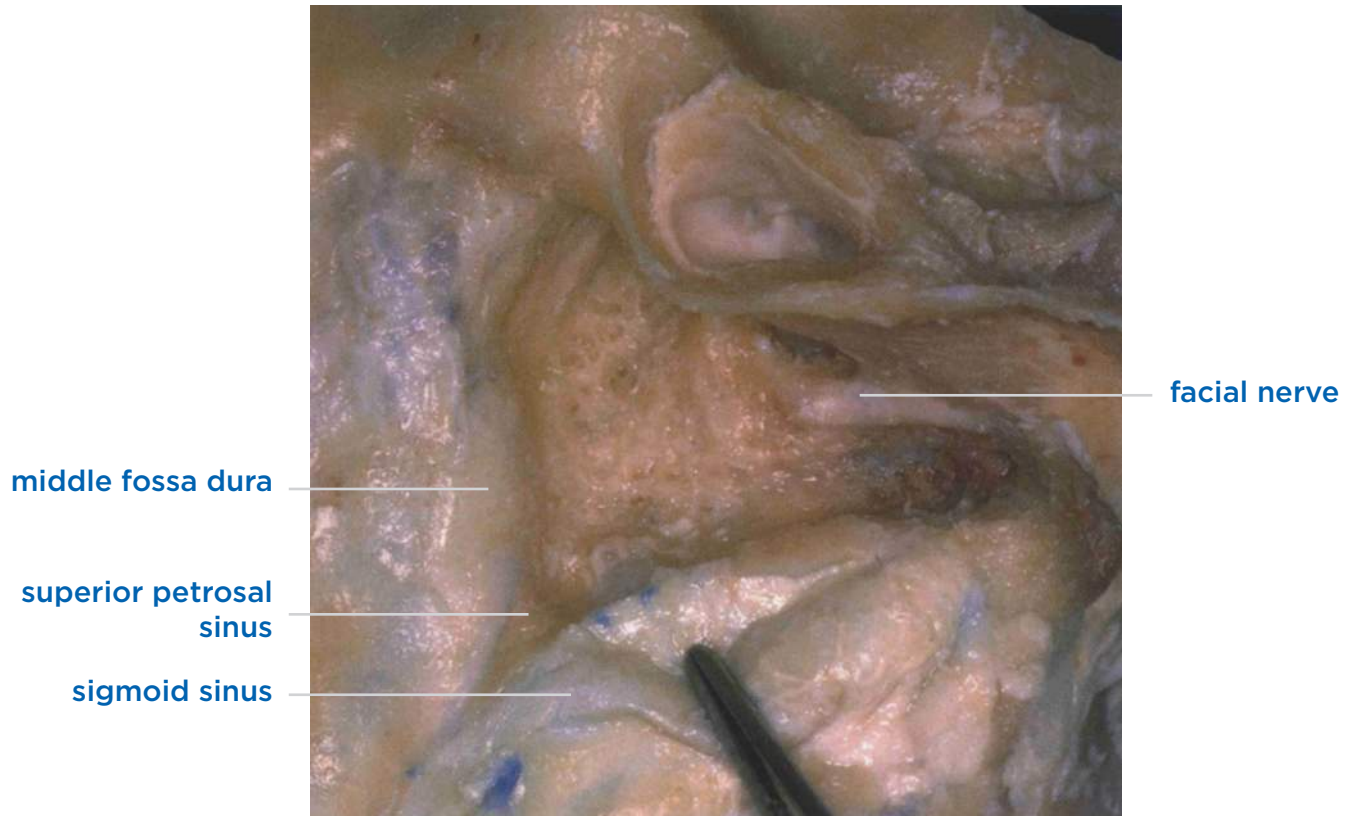
The translabyrinthine approach to the cerebellopontine angle is a lateral skull base procedure. This approach provides access to the internal auditory canal and cerebellopontine angle including the lateral aspect of the pons, cerebellar hemisphere and the 5th, 6th, 7th and 8th cranial nerves found within this space.

The primary indication for the translabyrinthine approach is acoustic neuroma removal. The translabyrinthine approach provides access to tumours ranging from small to extremely large in size. The labyrinth is sacrificed and therefore patients with useful hearing and smaller tumours benefit from alternative approaches such as the middle fossa approach (see page 37). The translabyrinthine approach may also be used for other tumours of the cerebellopontine angle such as meningioma or cholesteatoma when the hearing is not useful. Vestibular or cochlear nerve section is also possible with the use of this approach.

The advantage of the translabyrinthine approach is that wide exposure of the cerebellopontine angle and internal auditory meatus is achieved with minimal brain retraction. The sigmoid sinus, posterior fossa dura and middle fossa dura are uncovered following extensive removal of temporal bone. This allows displacement of these structures, and the cerebellopontine angle is thereby exposed without brain retractors.

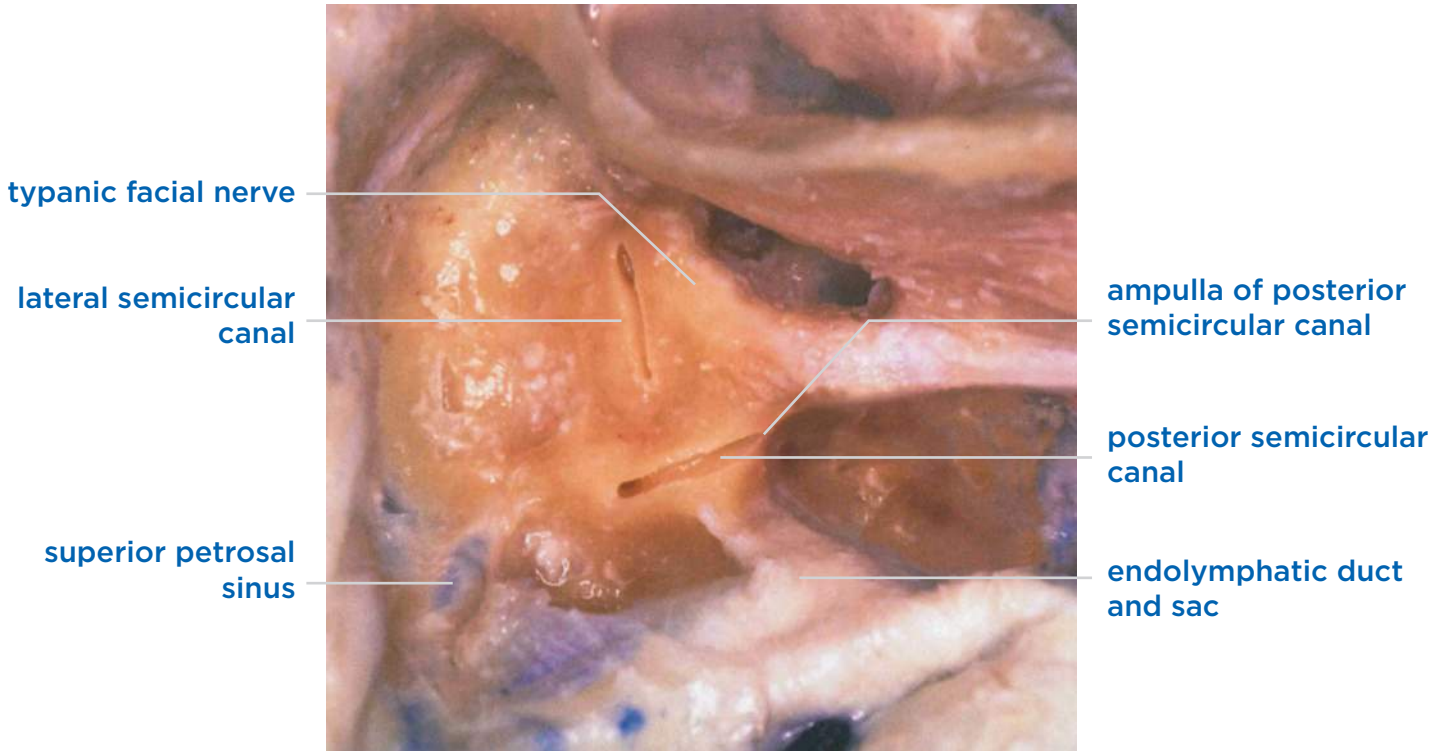
The translabyrinthine approach to the internal auditory canal and cerebellopontine angle requires an extended cortical mastoidectomy. The middle and posterior fossa dura are widely exposed followed by labyrinthectomy.

TRANSLABYRINTHINE APPROACH



- Middle fossa, sigmoid sinus and posterior fossa bone are completely drilled away to expose dura. The dura must be exposed posterior to the sigmoid sinus.
- The sigmoid sinus and posterior fossa dura may be compressed with the sucker irrigator to provide further access.
- The posterior fossa dura is widely exposed anterior to the sigmoid sinus.
- The retrofacial, retrolabyrinthine and sinodural air cell tracts are removed.
- The middle fossa dura is also widely decompressed.
- A posterior tympanotomy provides access for direct eustachian tube occlusion to prevent cerebrospinal fluid rhinorrhoea.

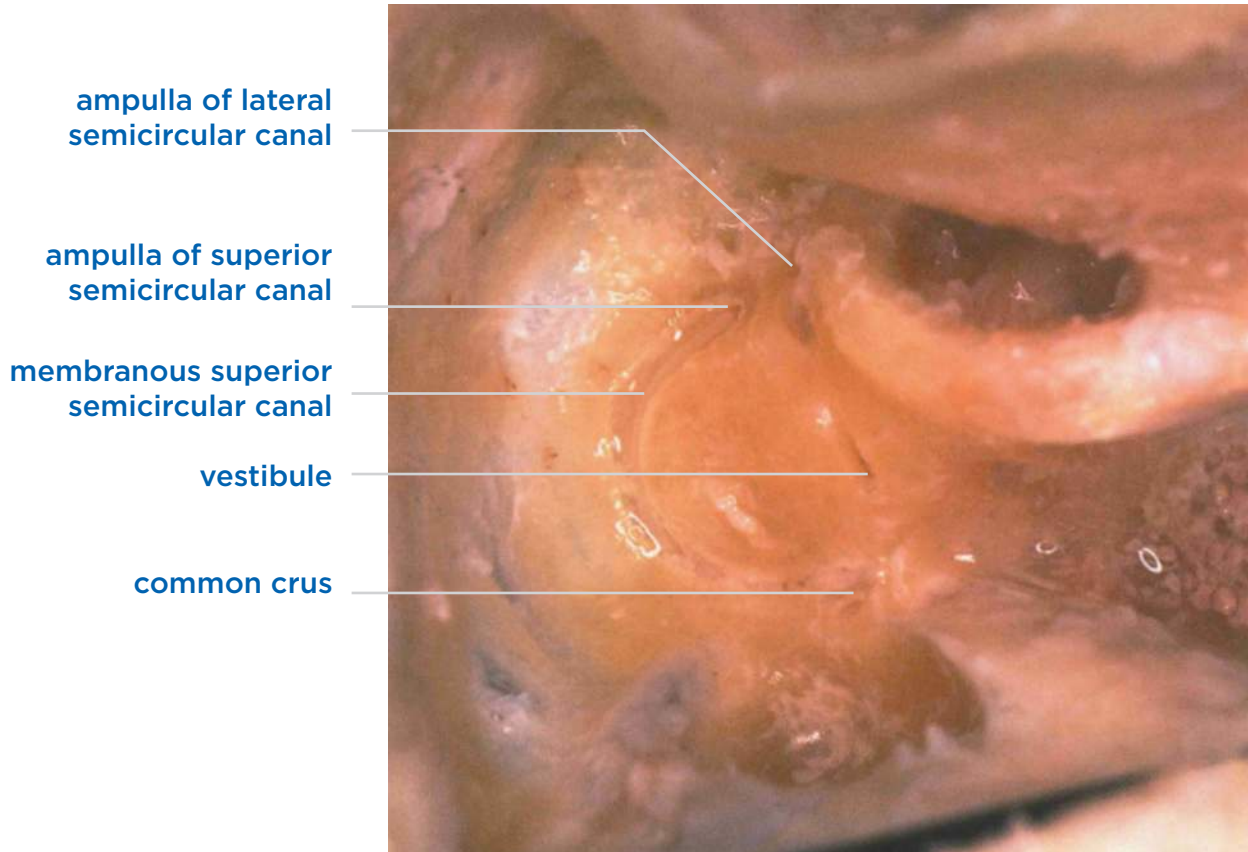
LABYRINTHECTOMY



Labyrinthectomy is occasionally used in the surgical management of vertigo, when patients have no useful hearing. Labyrinthectomy forms the next stage of the translabyrinthine approach.

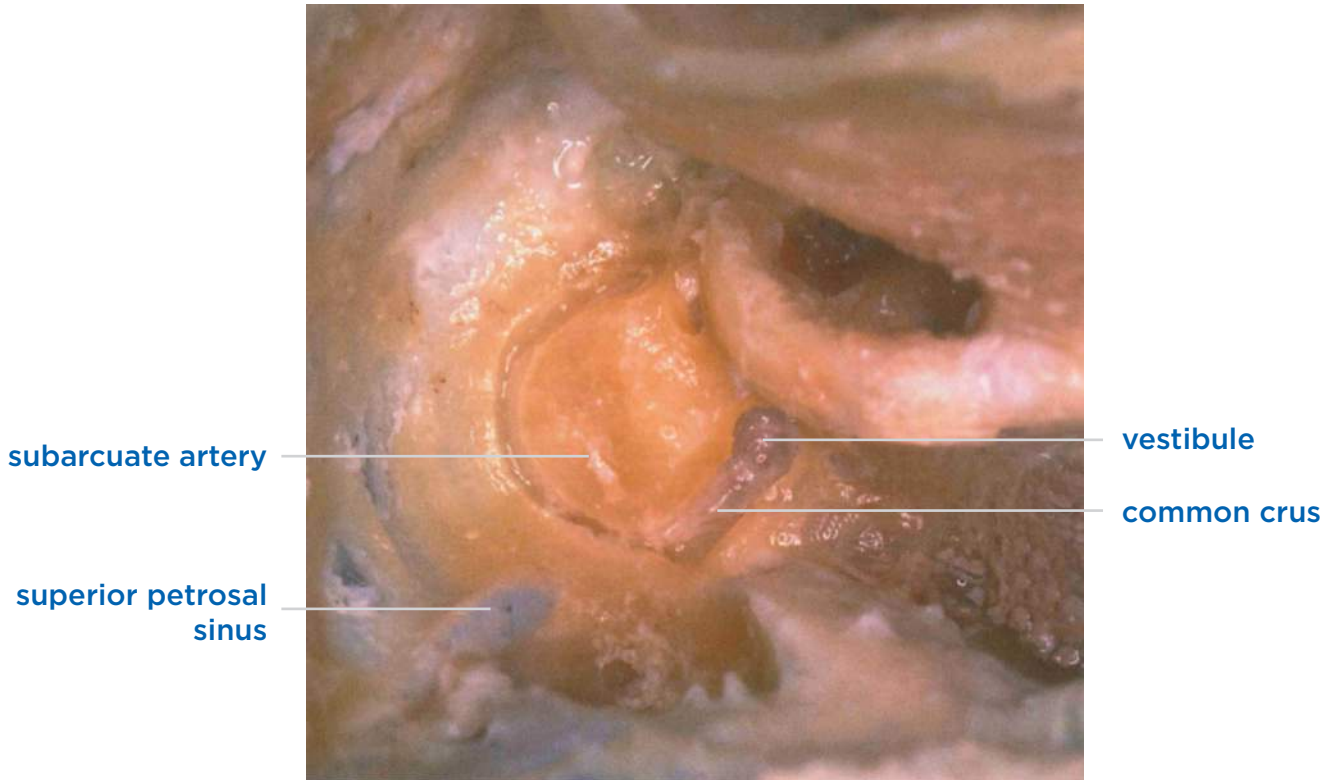
- The sinodural angle bone is removed with exposure of the superior petrosal sinus.
- The labyrinthectomy is begun by removing the posterior, and then the horizontal, semicircular canal. The canals are fenestrated after removal of surrounding air cell tracts.
- The endolymphatic duct is seen passing medial to the posterior canal.

LABYRINTHECTOMY



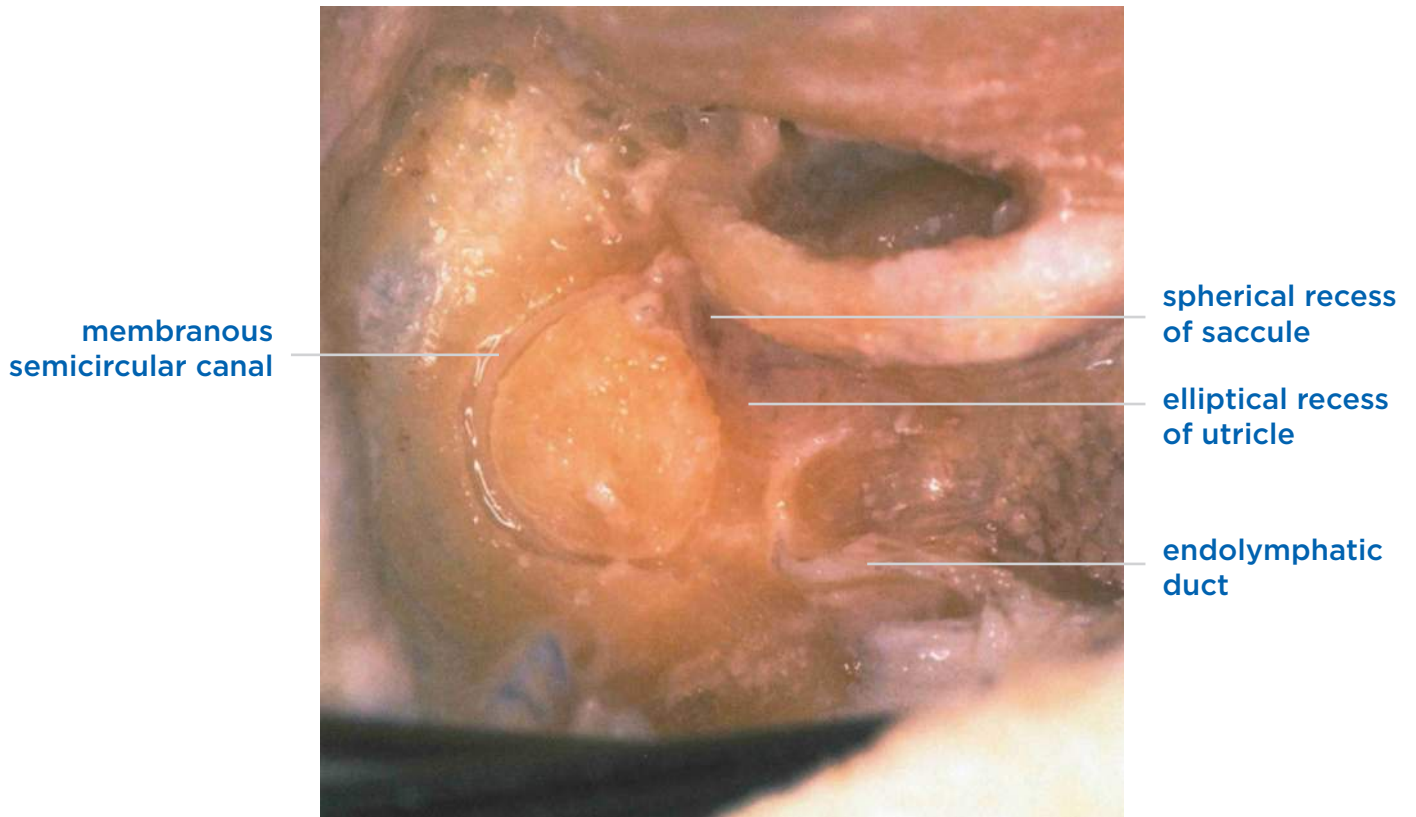
- The bone over the tympanic segment and pyramidal turn of the facial nerve is carefully removed to allow adequate exposure.
- The anterior wall of the lateral semicircular canal and ampulla of the superior canal are found immediately adjacent to the tympanic and labyrinthine segments of the facial nerve.
- The superior semicircular canal is removed, and the vestibule is exposed medial to the tympanic facial nerve.

LABYRINTHECTOMY

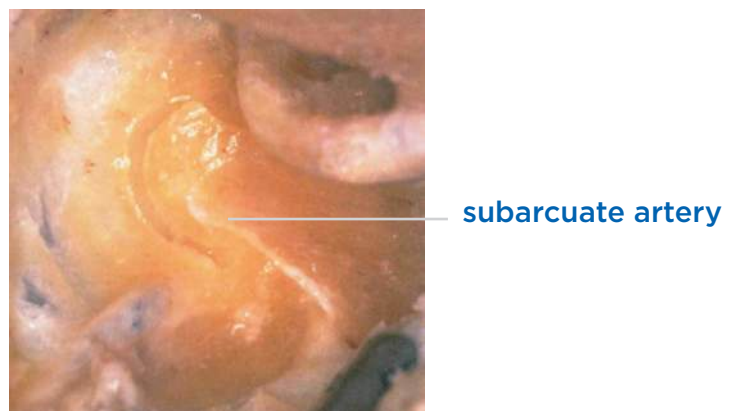


- The common crus is formed by the convergence of the superior and posterior semicircular canals and joins the vestibule.
- The subarcuate artery is seen coursing through the centre of the arc of the superior semicircular canal.

LABYRINTHECTOMY



- The endolymphatic duct is followed into the vestibule.
- All the neuroepithelium (cristae of the canals, saccule and utricle) is removed to complete the labyrinthectomy.
- The subarcuate artery is seen in the arc of the superior semicircular canal.



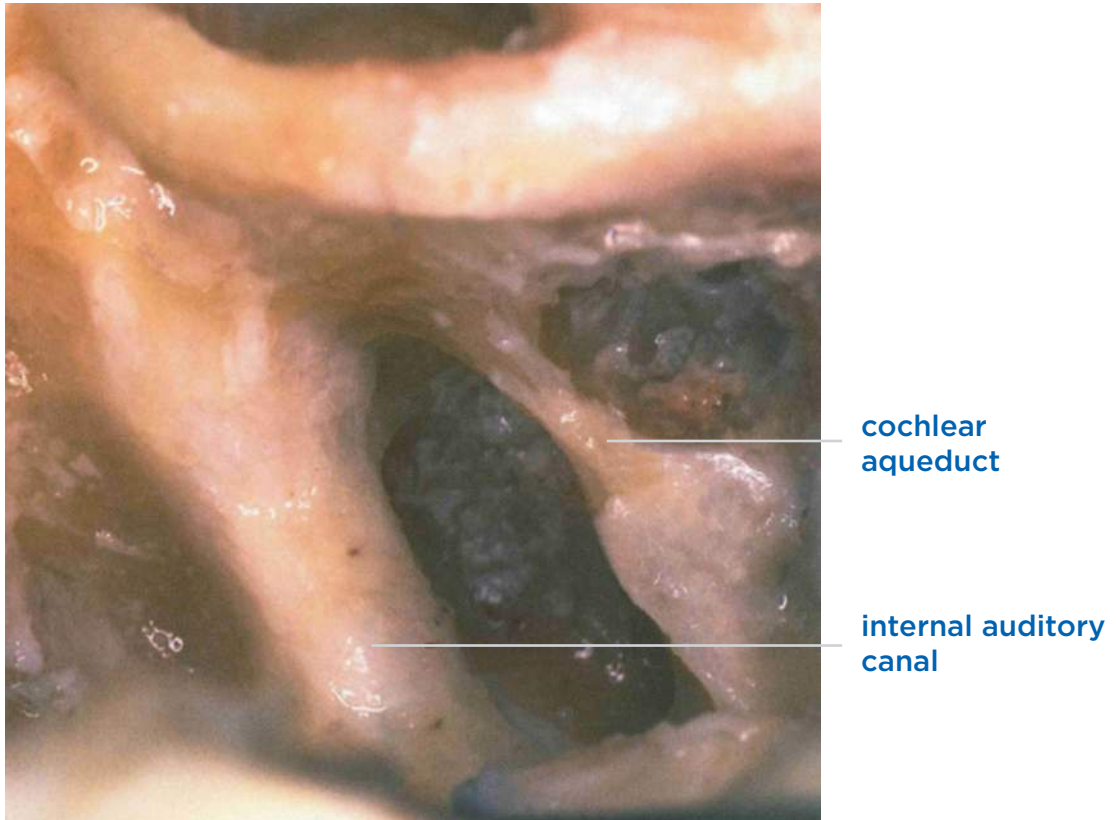
INTERNAL AUDITORY CANAL



Identification of the internal auditory canal is the next stage. The labyrinthectomy completes the second stage of the translabyrinthine approach to the internal auditory canal.

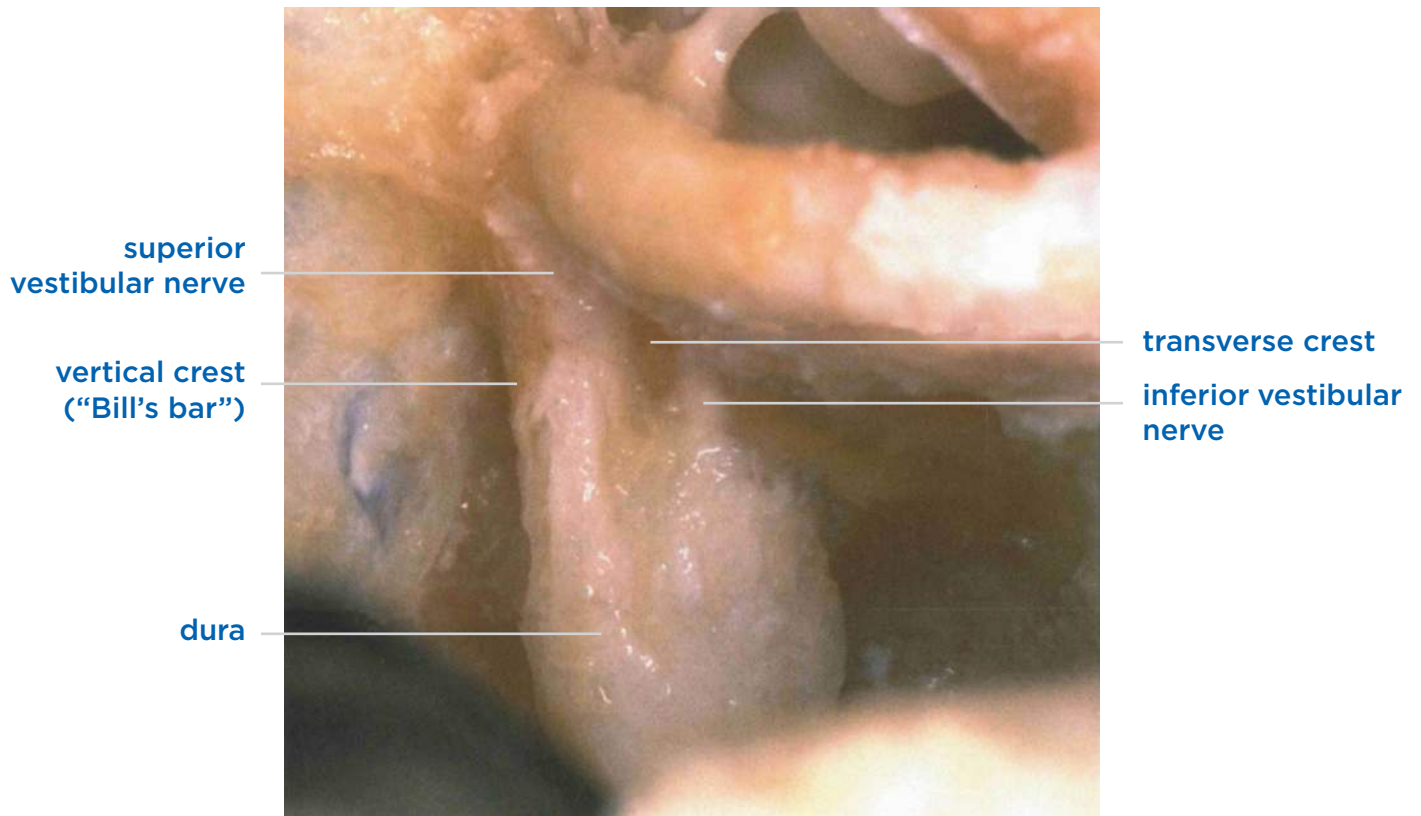
- The medial aspect of the vestibule defines the lateral end of the internal auditory canal.
- Identification of the internal auditory canal begins at the porus (medial) end. The bone removal continues along the posterior fossa dura.
- The internal auditory canal is identified and then skeletonised by extending the dissection superiorly and inferiorly around the canal to achieve exposure of 270 degrees or more.

INTERNAL AUDITORY CANAL



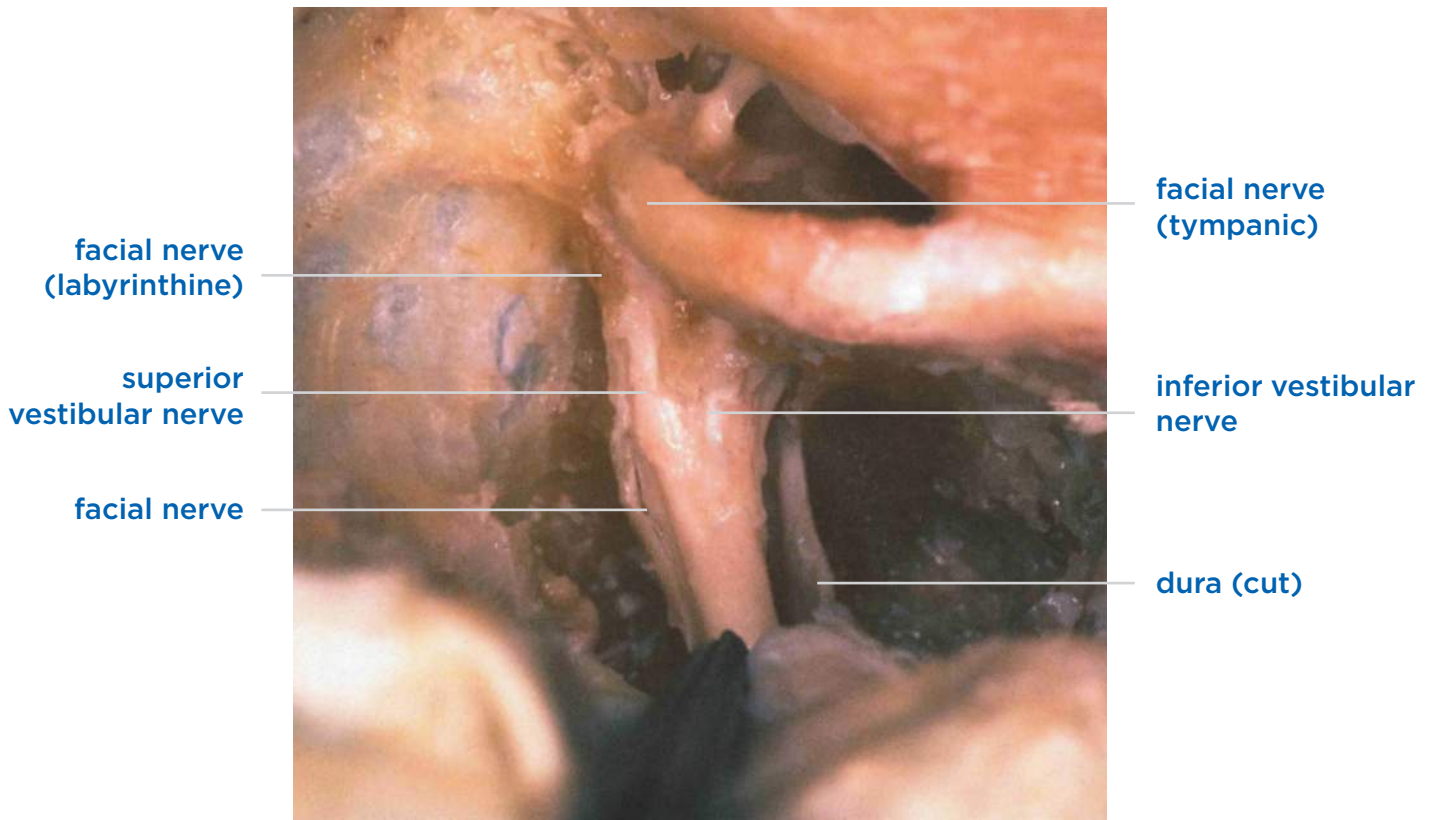
- The inferior dissection exposes the cochlear aqueduct and removes all the bone between the jugular bulb and the internal auditory canal.
- The superior dissection exposes the middle fossa dura and the superior portion of the internal auditory canal. The facial nerve lies within the canal in this region.
- Extensive bone removal provides wide exposure of the cerebellopontine angle after the dura has been opened.

INTERNAL AUDITORY CANAL



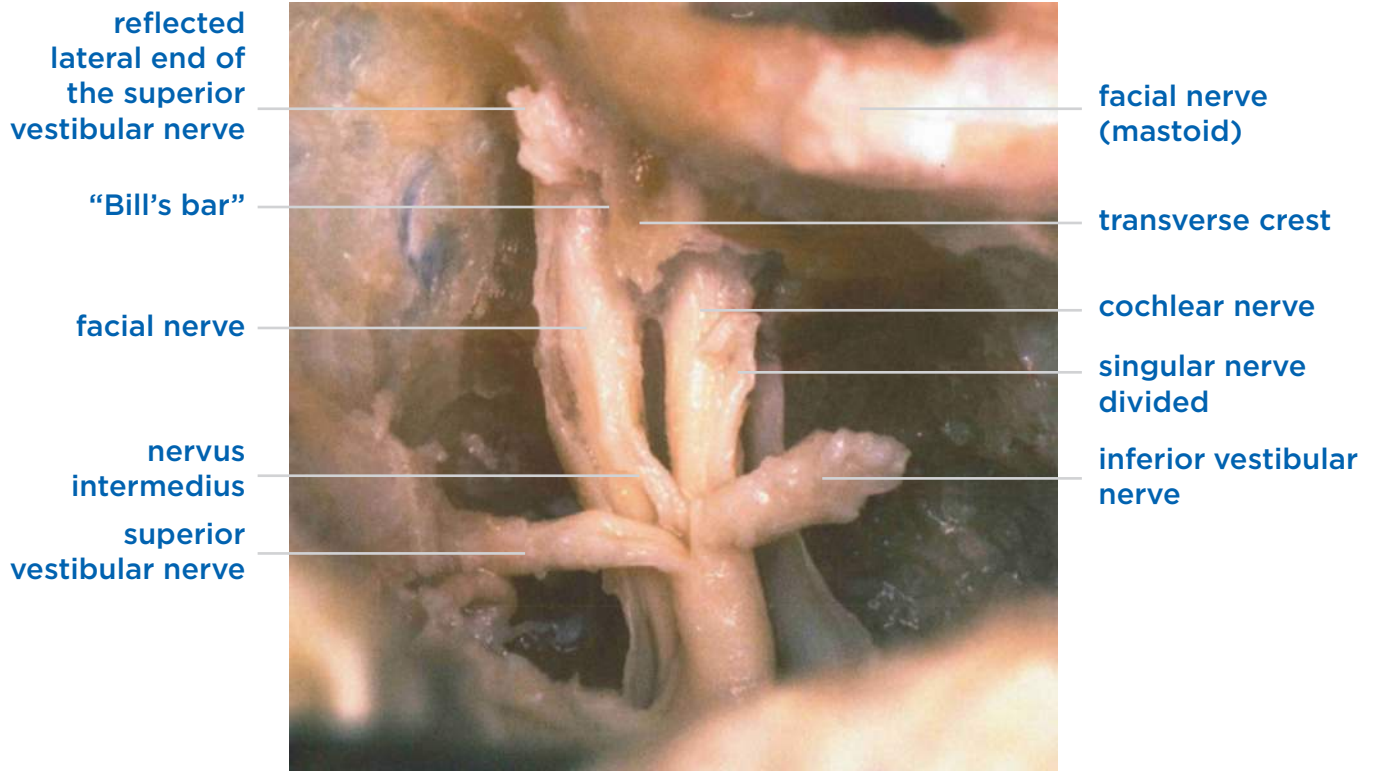
- Bony landmarks of the lateral end of the internal auditory canal are identified.
- The transverse crest separates the superior and inferior vestibular nerves.
- Vertical crest ("Bill's bar") separates the facial nerve from the superior vestibular nerve and is exposed by removing the remains of the ampulla of the superior semicircular canal.

INTERNAL AUDITORY CANAL



- Dura is opened at the inferior margin of the canal to avoid injuring a displaced facial nerve.
- The superior and inferior vestibular nerves are encountered first.
- The transverse crest is seen clearly separating these nerves.
- The entry point of the superior vestibular nerve into the vestibule is seen.

INTERNAL AUDITORY CANAL



- Division and reflection of the superior and inferior vestibular nerves reveal the facial and cochlear nerves respectively.
- The nervus intermedius runs in the internal auditory canal to join the facial nerve.
- The singular nerve leaves the inferior vestibular nerve to supply the posterior semicircular canal ampulla.

MIDDLE FOSSA APPROACH

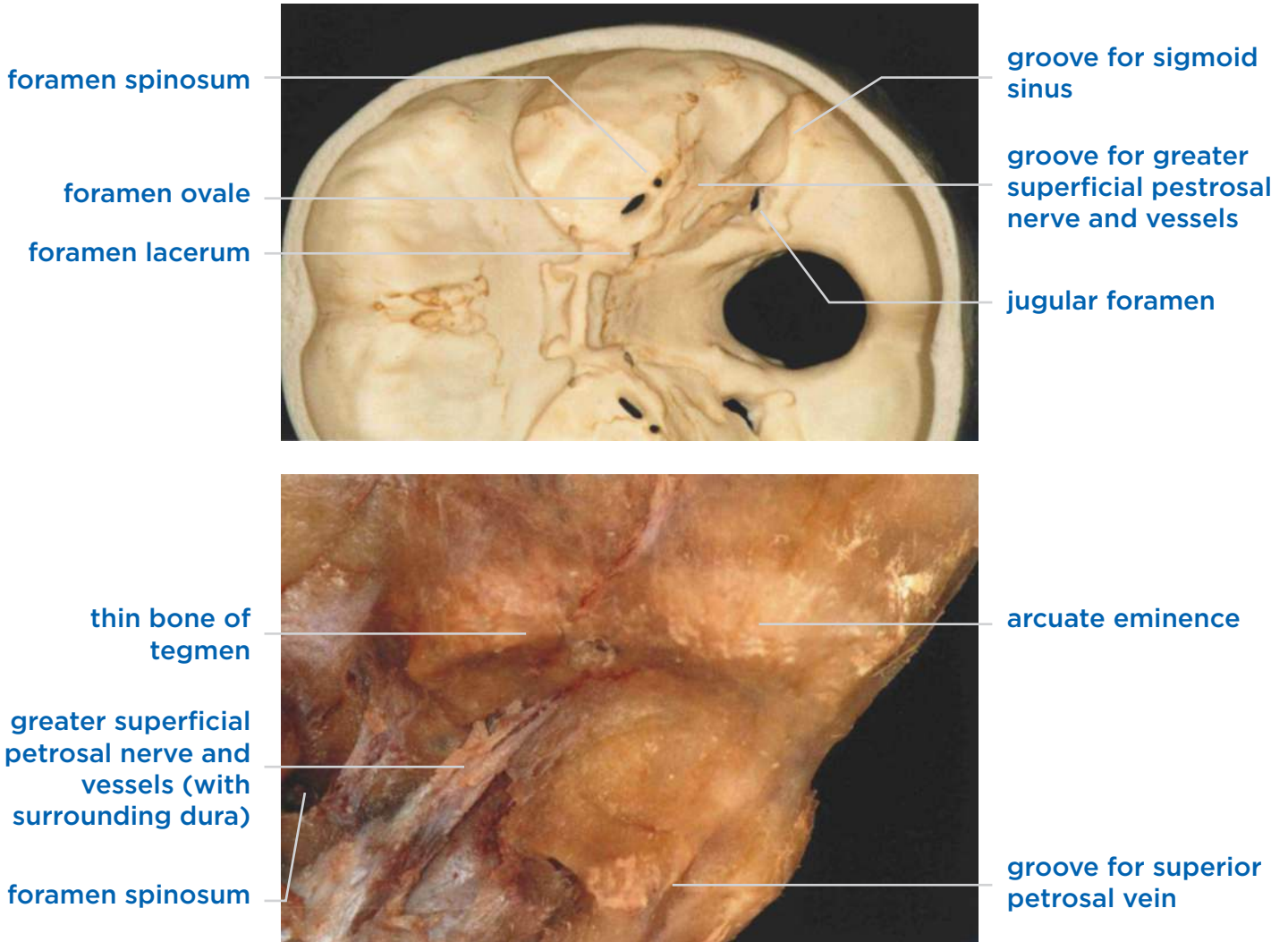
The middle fossa approach provides access to the internal auditory canal (IAM), without sacrificing the labyrinth. Extension of the classic approach provides access to the cerebellopontine angle. Further removal of the petrous apex bone provides an approach to the ventral pons and anterior cerebellopontine angle.

The primary indication for the middle fossa approach is intracanalicular acoustic neuroma removal when hearing preservation is planned. This approach is also used for vestibular nerve section and facial nerve surgery, as well as other tumours of the IAM. Extension of the classic approach provides better, but incomplete, access to the cerebellopontine angle and may be used for acoustic neuroma with posterior fossa extension.

The surgeon sits at the head of the operating table, with the operated ear uppermost. The anatomy of this approach is complex, and there are few landmarks on the anterior surface of the temporal bone.

- The arcuate eminence may be difficult to identify and does not always correspond to the superior semicircular canal.
- The middle meningeal artery courses through the foramen spinosum, and the third division of the trigeminal nerve passes through the foramen ovale.
- The other important landmark is the greater superficial petrosal nerve lying in a groove in the temporal bone.

MIDDLE FOSSA APPROACH



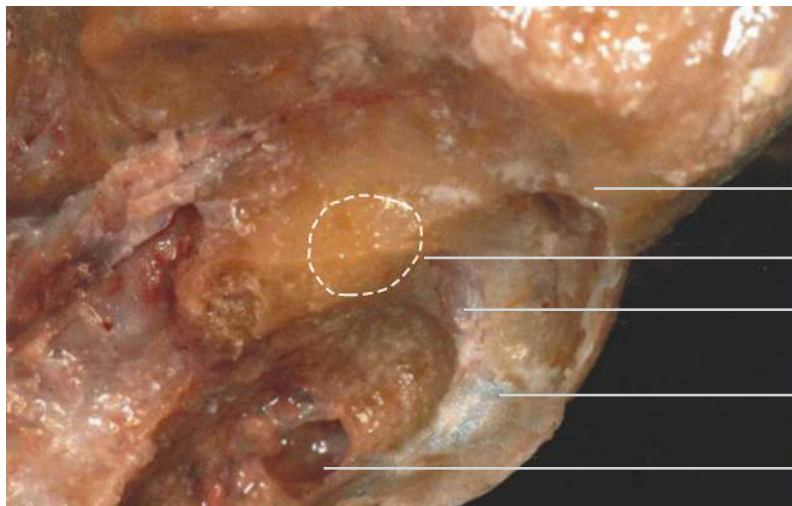
The IAM is found by utilising three alternative methods (sometimes in combination):

The IAM is found along a line that bisects the angle formed by the position of the arcuate eminence and the greater superficial petrosal nerve. The IAM is identified at the porus acousticus (medial end).

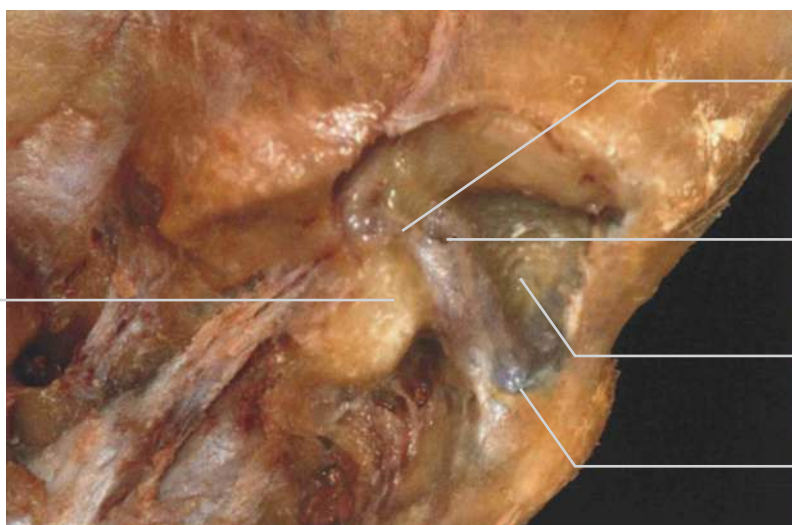
The greater superficial petrosal nerve is followed to the geniculate ganglion and then along the labyrinthine segment of the facial nerve to the internal auditory meatus.

The superior semicircular canal is “blue lined” and the IAM located at an angle of between 45° and 60°.

MIDDLE FOSSA APPROACH



- superior semi-circular canal
- region of cochlea
- internal auditory canal
- dura
- posterior fossa dura
- petrous apex air cells

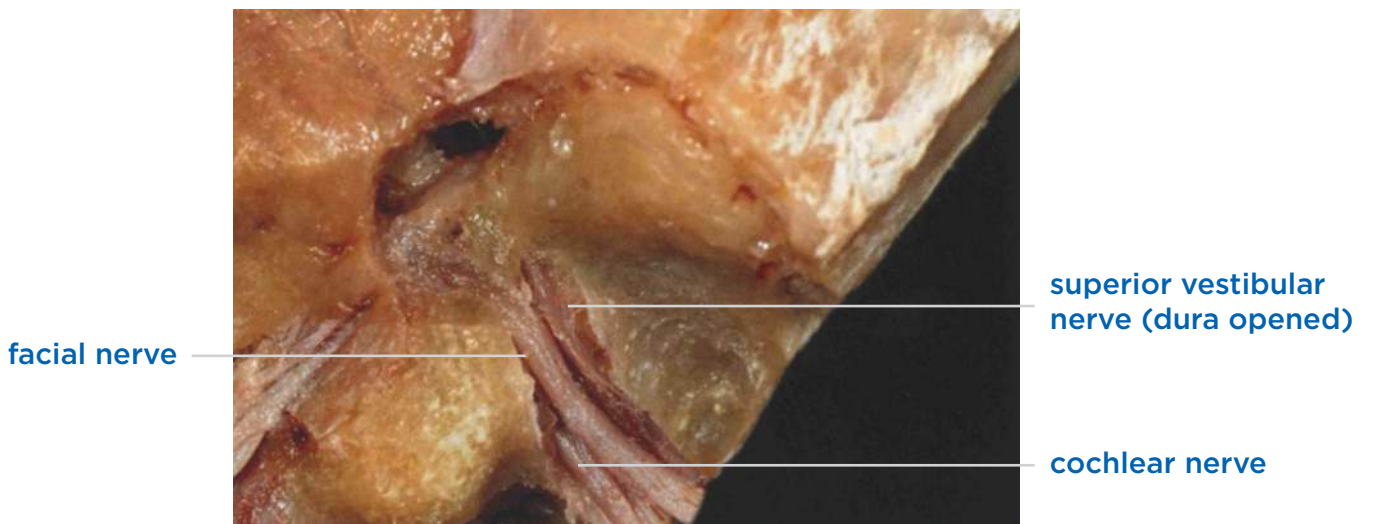
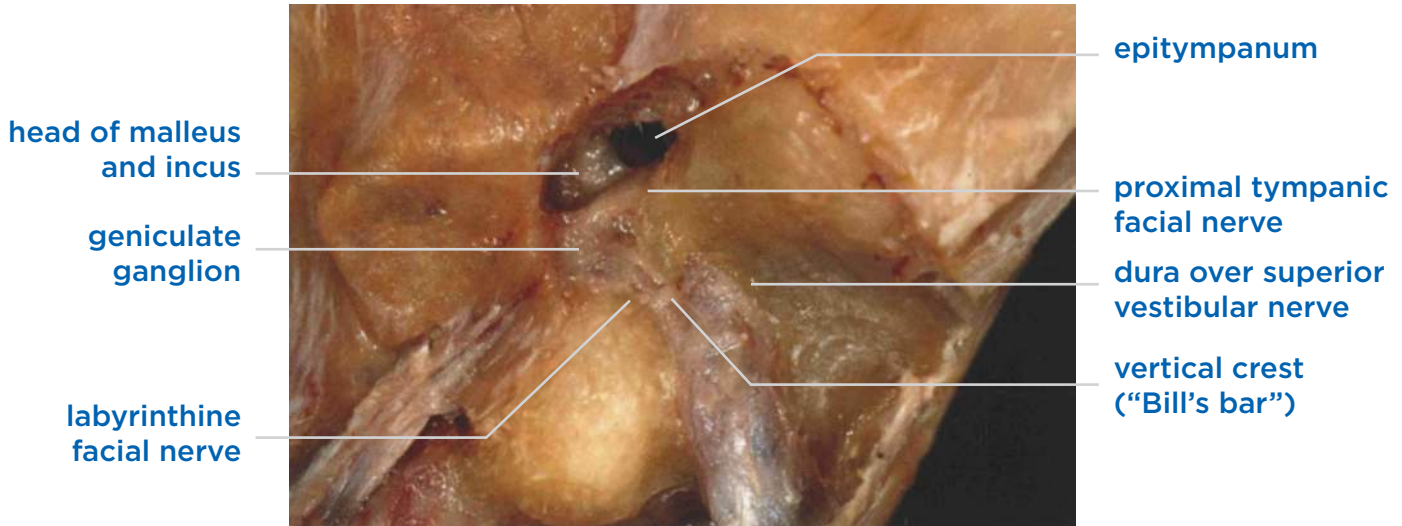


cochlea

- thin bone over labyrinthine segment of facial nerve
- lateral end of IAM
- air cells between superior semi-circular canal and IAM
- porus of IAM

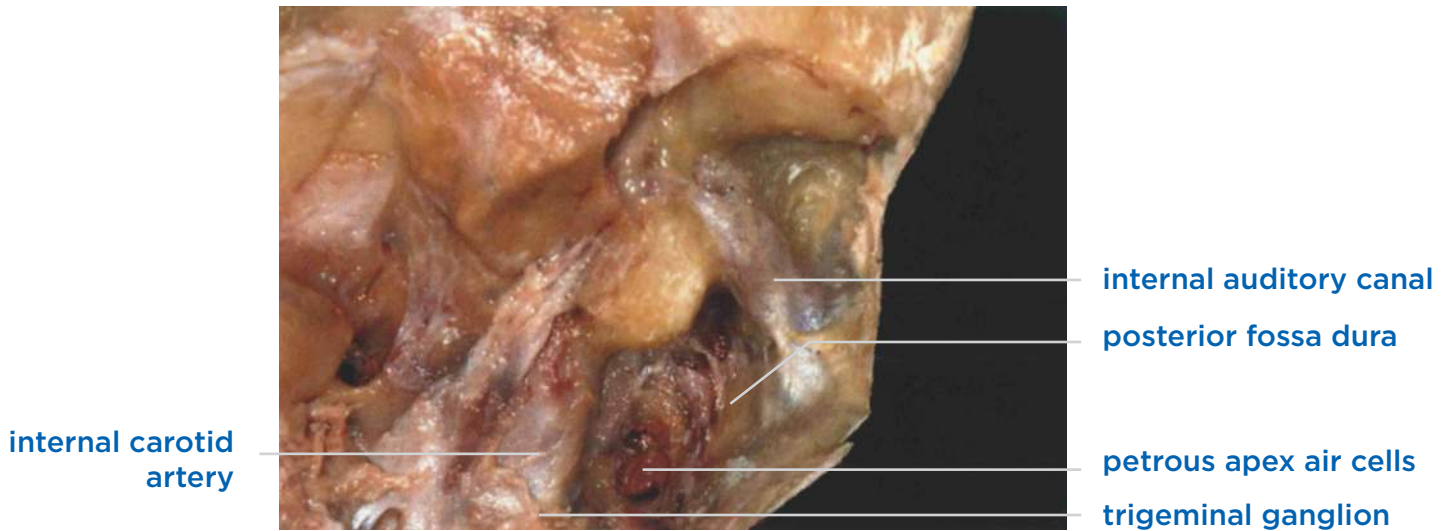
- The authors prefer method 1 but all approaches may be required. The IAM is found by drilling the petrous apex, anterior to the expected position of the canal.
- The dura of the IAM and porus is identified.
- Bone is removed around the IAM from medial (porus) to lateral.
- The cochlea is found adjacent to the anterior canal at the lateral third.

MIDDLE FOSSA APPROACH



- Wider bone removal provides better access to the cerebellopontine angle. Division of the superior petrosal sinus allows better posterior fossa exposure.
- Vertical crest is identified and the labyrinthine portion of the facial nerve exposed.
- The epitympanum is not routinely exposed in acoustic neuroma surgery but is shown here. Various skull base approaches eg. facial nerve tumours may require this exposure.

MIDDLE FOSSA APPROACH



- The internal carotid artery is found adjacent to the greater superficial petrosal nerve, which may need to be divided.
- The internal carotid artery is skeletonised and the petrous apex bone removed towards Meckel's cave containing the trigeminal ganglion.



Perth
Western Australia
ABN 48 804 903 003

earsience.org.au