

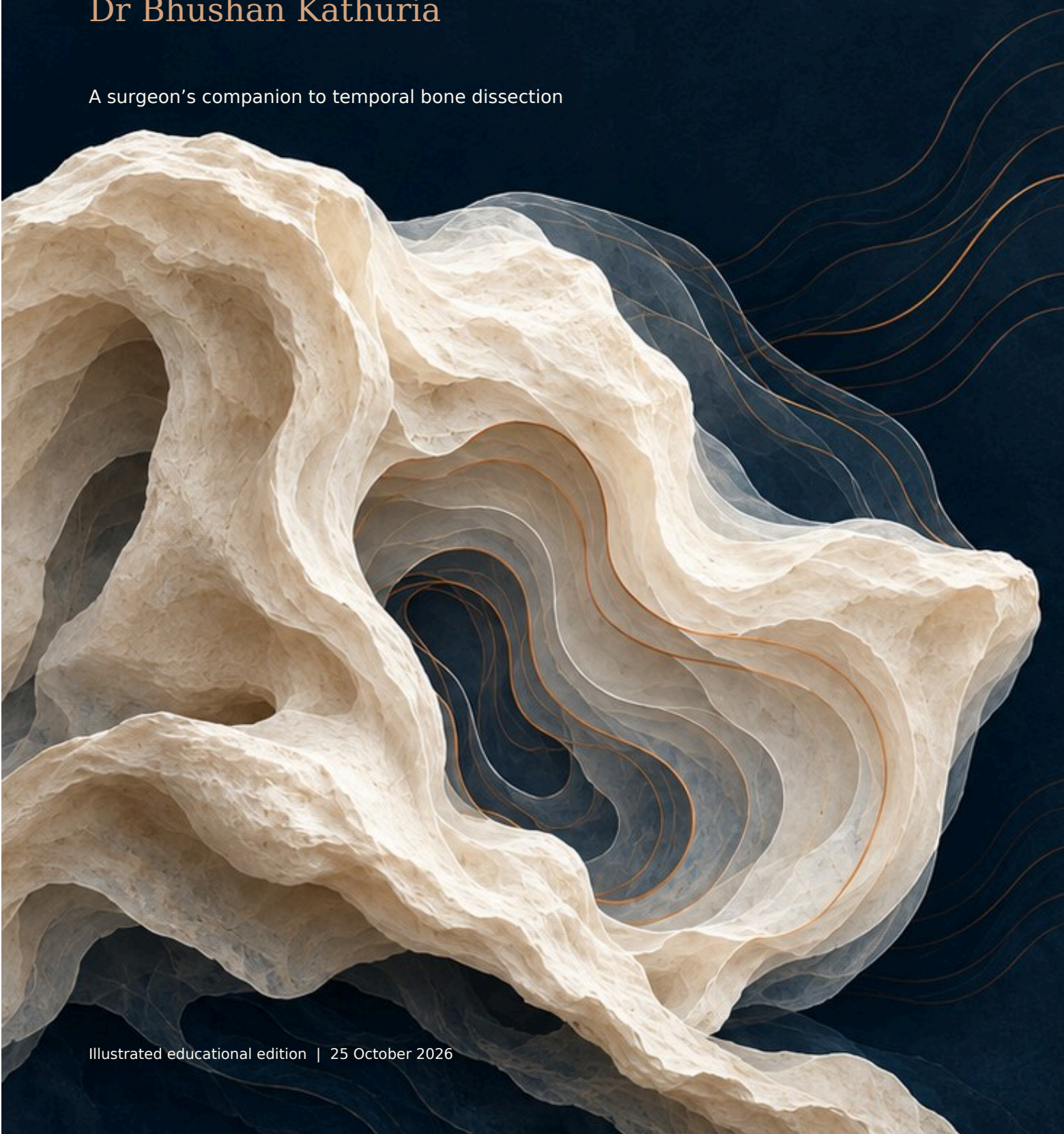
WITHIN THE TEMPORAL BONE

Anatomy, technique and surgical judgement

Dr Bhushan Kathuria

A surgeon's companion to temporal bone dissection

Illustrated educational edition | 25 October 2026



Publication and edition notes

Within the Temporal Bone | Dr Bhushan Kathuria

Free educational edition · 25 October 2026. Seventeen chapters on supervised temporal bone study, with study companions, dissection records, terminology and references.

Publication platform

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For supervised professional education. This manual does not replace clinical training, local protocols or patient-specific judgement. The cover is abstract artwork, not anatomical evidence.

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Open surgical education

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I also acknowledge Umut Tan Sevgi and colleagues for their published microsurgical anatomy study of skull-base corridors. Selected figures and panels are reproduced with source attribution and licence information in the operative plate register.

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Professional review

I am grateful for the independent specialist review undertaken during preparation of the manuscript. Its completion has been confirmed by the author. The subsequent addition of source plates is documented separately so that the review record remains clear.

Dr Bhushan Kathuria

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ENT, Head & Neck Oncosurgeon; Endoscopic Skull Base Surgeon; Cochlear Implant Surgeon. The author initiated the manual, directed its scope and visual approach, and remains responsible for final clinical and publication decisions.

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Visual contributions

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Preface

Temporal bone dissection gives anatomy a working context. Structures learned separately in a textbook appear together in a small field, and each alteration of that field changes what can be seen and what can be injured. The value of the laboratory lies in learning these relationships while developing controlled, reproducible instrument handling.

This manual is written for ENT trainees, fellows and surgeons undertaking supervised temporal bone study. It follows the progression from specimen preparation and elementary bone work to mastoid, middle-ear and selected lateral skull-base dissections. Anatomy is introduced beside the technique it explains. Variations and common errors are discussed within the relevant exposure, so that they remain part of the surgical account rather than an unrelated list at the end.

The early chapters establish the working habits on which later dissections depend. Cortical mastoidectomy is the central exercise. Subsequent chapters develop particular routes from that exposure, then examine the structures that those routes preserve or sacrifice. Advanced chapters describe anatomical dissections and the principles of exposure; they are not substitutes for specialist training in live skull-base surgery.

A specimen cannot reproduce bleeding, nerve function, hearing, tissue healing or the consequences of injury in a patient. A completed laboratory exercise demonstrates a particular anatomical and technical achievement. It does not establish independent operative competence. Use this manuscript alongside direct instruction, current institutional protocols and the manufacturer's instructions for instruments and implants. The author reports that independent specialist verification has been completed; the newly added source plates are recorded separately in this edition.

How to use the manual

Read the relevant chapter before starting and keep the text available during the instructor's demonstration. Examine the specimen before selecting a dissection. A preserved ear with an intact tympanic membrane, ossicular chain and intracranial surface offers different possibilities from a previously drilled or incomplete bone. Record what is absent before interpreting the result.

Plan the order of work. Transcanal middle-ear study and intact-chain inspection should precede exercises that remove ossicles. An intact canal-wall mastoidectomy and facial recess exposure should be studied before taking the canal wall down. Identify the labyrinth's external relationships before opening it. Complete hearing-preserving anatomical exercises before destructive inner-ear or extended skull-base work. Where these aims compete, use separate specimens rather than treating one damaged specimen as suitable for every chapter.

Each procedural chapter describes preparation, the anatomy encountered during exposure, a practical sequence, variations and completion. These sections are guides to a supervised dissection. The instructor should adapt the extent and sequence to the specimen and the learner. Fixed drilling distances, universal burr sizes and timed completion targets are deliberately avoided because they can conceal important anatomical and equipment differences.

References identify selected anatomical and technical reading. Six detailed illustrations from the supplied pilot are integrated into Chapters 6 and 7. Each chapter also has a study companion with a conceptual graphic and a discussion question. These diagrams summarise relationships or reasoning and do not depict operative geometry. Twenty-nine additional source plates provide operative and specimen views. Specialist verification of the preceding material has been reported complete by the author; the new plate selection is documented separately.

CHAPTER 01

Laboratory preparation and specimen care

Select a specimen for the intended exercise

The preparation of the specimen determines the quality of the anatomical lesson. Before mounting the bone, establish its side, provenance, preservation method and completeness. Note whether the external canal, tympanic membrane, ossicular chain, mastoid tip, petrous apex and intracranial dura are available. Previous dissection, fractures and tissue loss should be documented. An apparently abnormal relationship may be the consequence of harvesting rather than an anatomical variation.

Human tissue must be obtained, handled, stored and disposed of under the laboratory's applicable consent, governance and infection-control arrangements. Respect for the donor includes accurate identification, careful use of the specimen and appropriate handling of photographs. Educational images should carry the specimen identifier rather than identifiable donor information.

Wet specimens generally preserve soft-tissue relationships better than dry bones, although fixation changes texture and colour. Dry bones help demonstrate osseous anatomy but cannot support conclusions about normal mucosal planes or membrane behaviour. Printed and synthetic models provide repeatable practice opportunities, but their cutting properties and the visibility of nerves or vessels may differ substantially from human bone. Record the model type when assessing performance.

Establish the working field

Secure the specimen firmly enough that drilling cannot rotate it. Support the bone in the holder without crushing a region that will be needed later. Orient the lateral surface towards the operator for initial mastoid work, then adjust the holder to the planned route rather than compensating with an awkward instrument angle. Identify the specimen's side on the holder and on the dissection record.

Arrange the microscope, chair and bench before placing instruments in the field. The learner should be able to sit upright, support the forearms and reach suction, irrigation and the drill pedal comfortably. Check that tubing and cables do not pull on the handpiece or disturb the holder. A stable setup allows small movements to remain small; a poorly arranged setup turns routine changes of view into interruptions.

Inspect the drill, handpiece and burr coupling according to the equipment instructions. Test rotation away from tissue. Confirm the availability and direction of irrigation, the effectiveness of suction and the function of the illumination. Place microinstruments in a consistent order with their tips protected. The laboratory should specify splash protection,

dust and aerosol controls, ventilation and cleaning appropriate to its materials and preservation chemicals.

Preserve the learning opportunities

Before tissue removal, inspect the intact surface and take an orientation photograph. Preserve canal skin and the tympanic membrane if middle-ear work is planned. Do not strip every soft tissue simply to produce a cleaner picture. Tendons, ligament attachments, dura and nerve coverings may be necessary for later anatomical interpretation.

Keep the specimen appropriately hydrated using the laboratory's approved method. Drying can make delicate tissues brittle and alter their appearance. Avoid assuming that a change in colour represents a deeper structure; it may reflect fixation, desiccation, illumination or a previous exposure.

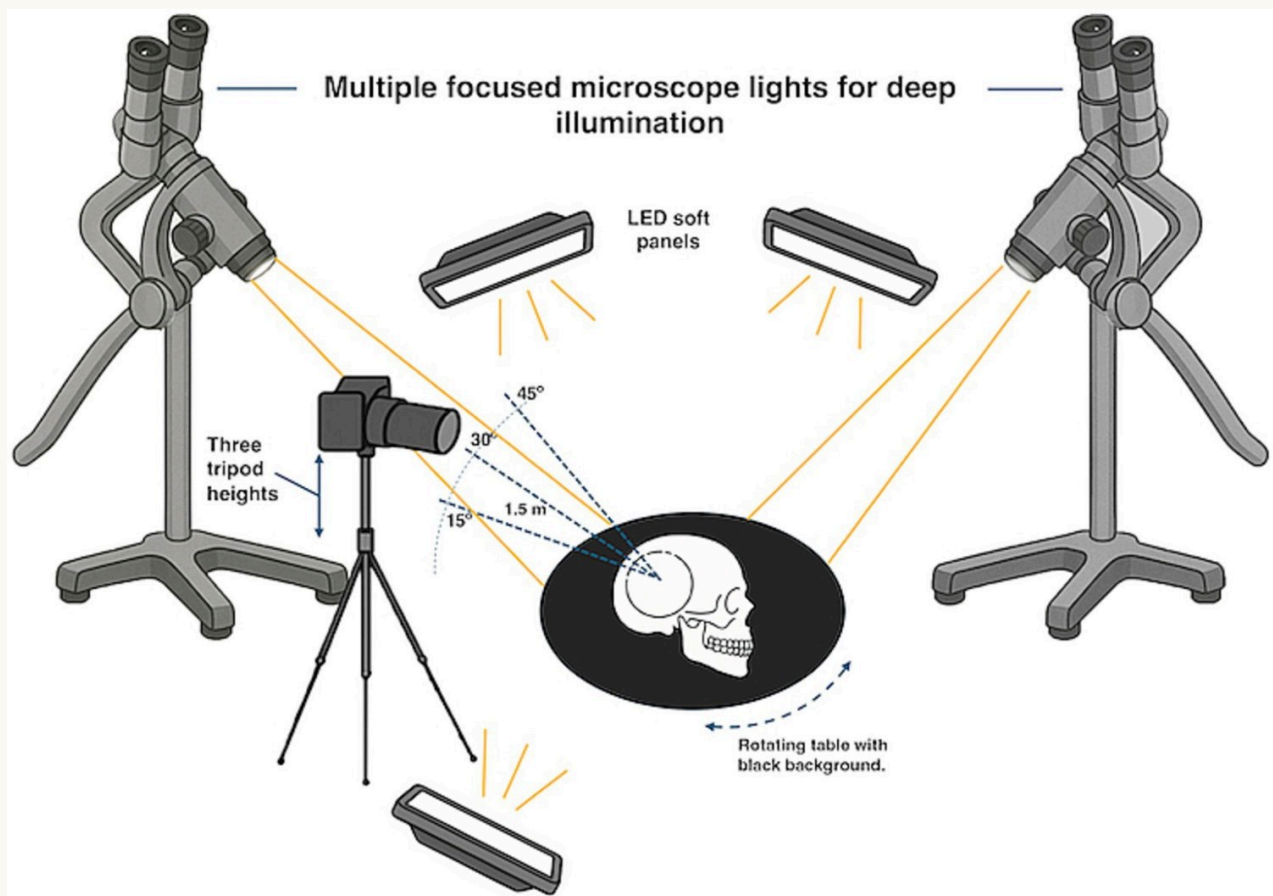
Choose the session's endpoints with the instructor. On a new bone, it may be more useful to complete one exposure carefully and retain the remainder for another session than to open every compartment in one sitting. Mark the boundaries of completed work on the record. Store the specimen securely with its identifier and accompanying images so that subsequent work begins from a known anatomical state.

At the end of the session

Account for instruments and detachable components, remove sharps according to local practice and clean the field using the laboratory protocol. Record intentional resections and unintended breaches separately. Photograph the final view with the same orientation as the starting image where possible. This record makes the next dissection more informative and permits the instructor to assess what actually changed.

CHAPTER 01 / OPERATIVE PLATE 1.11

Documenting a specimen

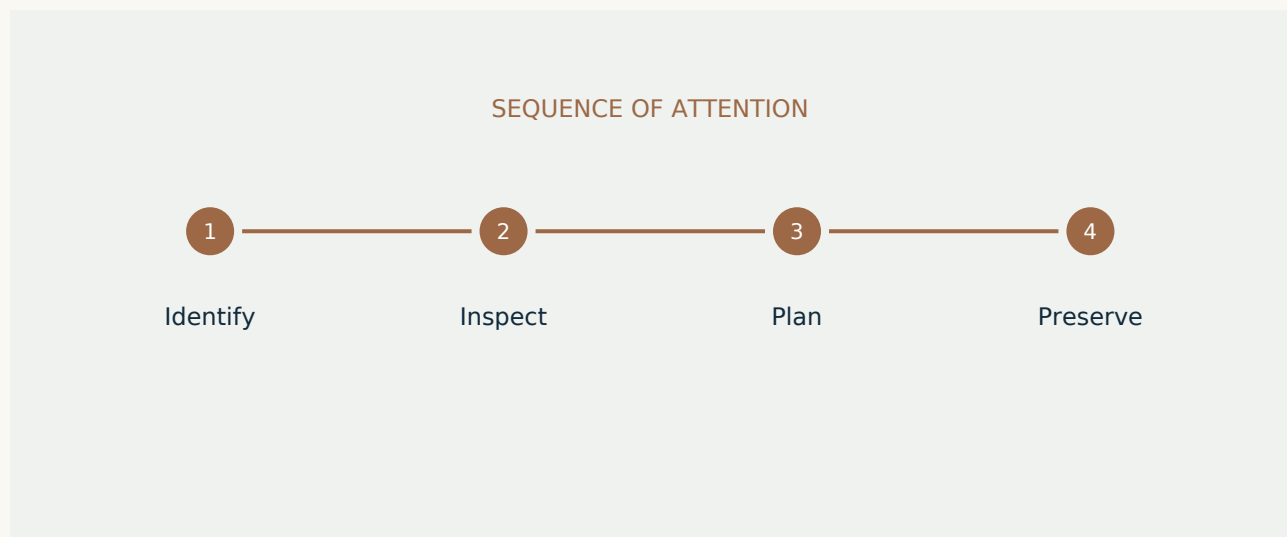


Published photogrammetry setup for documenting a skull specimen, including lighting, camera and rotating support. This is a research documentation example, not a mandatory dissection-bench arrangement.

Source figure 1. Sevgi UT et al. Anterolateral, lateral, and posterior corridors to complex skull base lesions (2026). Front Neurol 17:1736101. CC BY 4.0.

CHAPTER 01 / STUDY COMPANION

Preserve tomorrow's dissection



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Before work Record side, preservation, fractures and earlier drilling.

During work Retain tissues needed for later exposures and reconstruction.

After work Separate intended removal from unintended change in the record.

Discuss at the specimen

The ossicular chain is already disrupted. Can this bone demonstrate atraumatic chain preservation?

No. It can support other suitable exercises, but cannot demonstrate preservation of a chain that was damaged before the session. Document the starting defect.

Record

Which planned exercise is no longer interpretable on this specimen?

CHAPTER 02

The microscope, drill and microinstruments

Seeing before cutting

Begin at a magnification that shows the whole intended field. Adjust interpupillary distance, focus and eyepieces before working. Both eyes should see a comfortable fused image. Increasing magnification improves inspection of a small region but reduces the surrounding context and depth of field; return periodically to a wider view when the direction of the dissection becomes uncertain.

Move the specimen or microscope to obtain a useful line of sight. Bending the wrist or neck to maintain an unfavourable view is a poor substitute. The instrument tip and the structures immediately around it should remain visible throughout contact. If the handpiece or suction obscures the point of work, alter the arrangement before continuing.

Develop controlled bone removal

Hold the drill with a stable, relaxed grip and support the hand where the setup permits. The handpiece should respond to small deliberate movements without requiring sustained force. Practise on expendable cortical bone before approaching fine anatomy. Observe how the burr behaves during contact, how quickly it removes material and how irrigation changes the view.

A cutting burr is efficient for bulk bone removal; a diamond burr offers a different cutting behaviour useful for controlled work near delicate boundaries. Neither is inherently harmless. The entire active surface, and occasionally the shaft or adjacent handpiece, can injure tissue. Select a burr that fits the visible space and intended task. A very small burr does not automatically make an uncertain dissection safer.

Use controlled strokes within the visible field rather than allowing the tip to create an unobserved deep hole. Do not increase pressure to compensate for a blunt burr, an unsuitable approach angle or inadequate exposure. If the burr chatters, skates or catches, lift it away, stop and correct the cause. Confirm that the instrument is secure and functioning normally before returning to the specimen.

Irrigation clears debris and helps limit heat. Direct suction to maintain a readable field without constantly obscuring the burr. Near fragile structures, the suction tip itself requires the same attention as the drill. Packed bone dust can conceal a boundary, while an excessively flooded field may hide the point of contact. Adjust both systems rather than accepting either condition.

Transition to microdissection

Use elevators, picks and hooks for a purpose that matches their tip geometry. Introduce and withdraw instruments under vision. A hook whose end is hidden behind a structure may transmit force to an unseen attachment. If tissue does not separate as expected, inspect the plane and attachment before applying more traction.

Near the ossicular chain, distinguish a small intended displacement from movement transmitted to the stapes. Support the relevant structure and keep the direction of force visible. Avoid using the ossicles as a hand rest or a fulcrum. Once a joint or tendon has been divided, acknowledge that the mechanical state of the chain has changed before testing movement again.

Use an endoscope deliberately

An endoscope can reveal recesses outside the microscope's direct line of sight. The image is two-dimensional, and the instrument approach must remain visible as well as the target. Introduce the scope under observation, identify its orientation and withdraw it when changing an angle that might contact tissue. Do not infer safe instrument access merely because an angled lens reveals a recess.

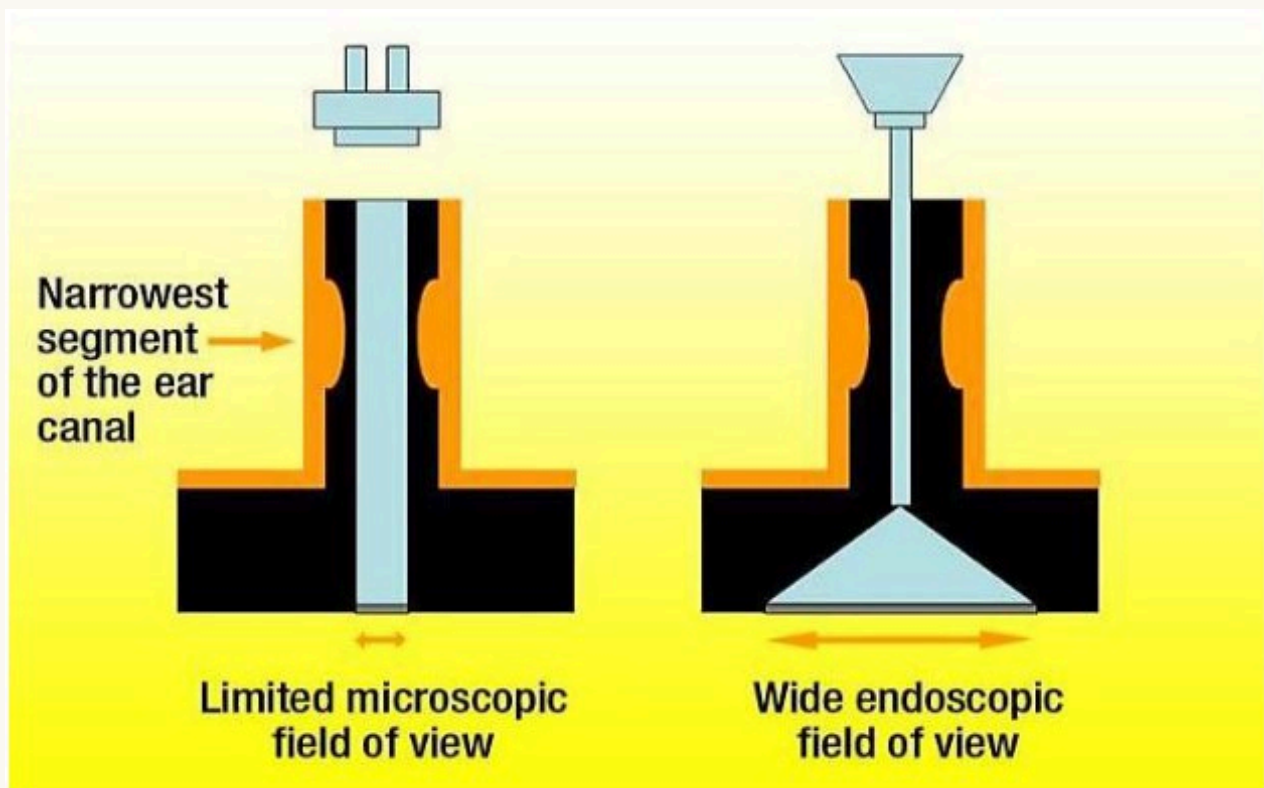
Experimental work in human temporal-bone models has demonstrated heating associated with endoscopic illumination. [6] Use an appropriate light level, avoid prolonged stationary contact and follow the equipment and local cooling practices. The scope is an instrument occupying the same confined field as the dissector; its shaft and tip must be accounted for throughout the exercise.

Recognise technical errors early

A recurring loss of focus suggests a setup or specimen-position problem. Excess pressure suggests an instrument, visibility or technique problem. Repeated collision of instruments suggests inadequate access or poor hand arrangement. Correct these causes before interpreting slow progress as a lack of speed. Efficient dissection develops from a clear field, suitable instruments and economical movements.

CHAPTER 02 / OPERATIVE PLATE 2.11

Two routes, different fields

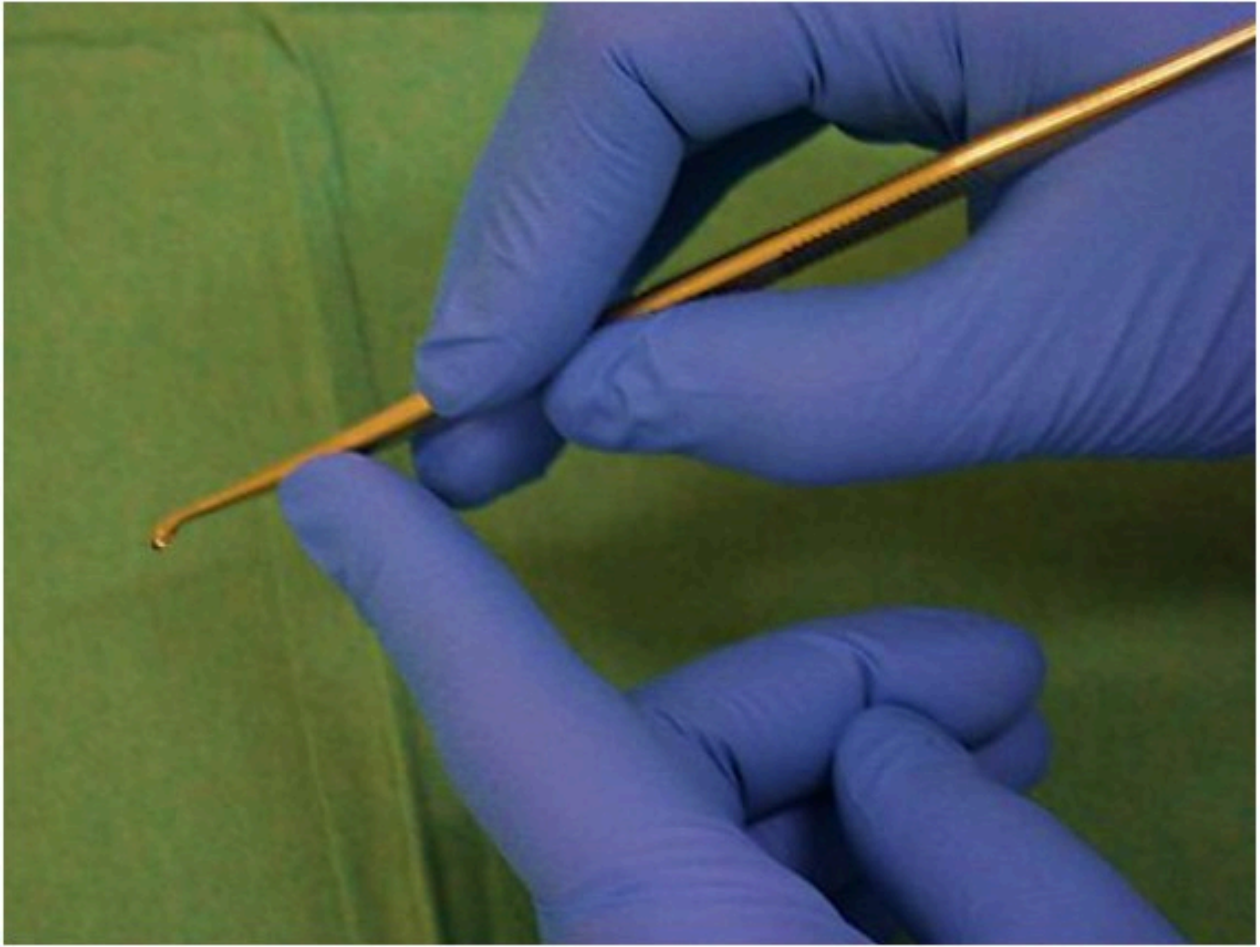


Optical comparison of microscopic and endoscopic views. The source drawing illustrates access and line of sight; it is not a scale model.

Source figure 1. Tarabichi M. Endoscopic cholesteatoma, tympanoplasty and middle ear surgery (2013). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 02 / OPERATIVE PLATE 2.12

Instrument control

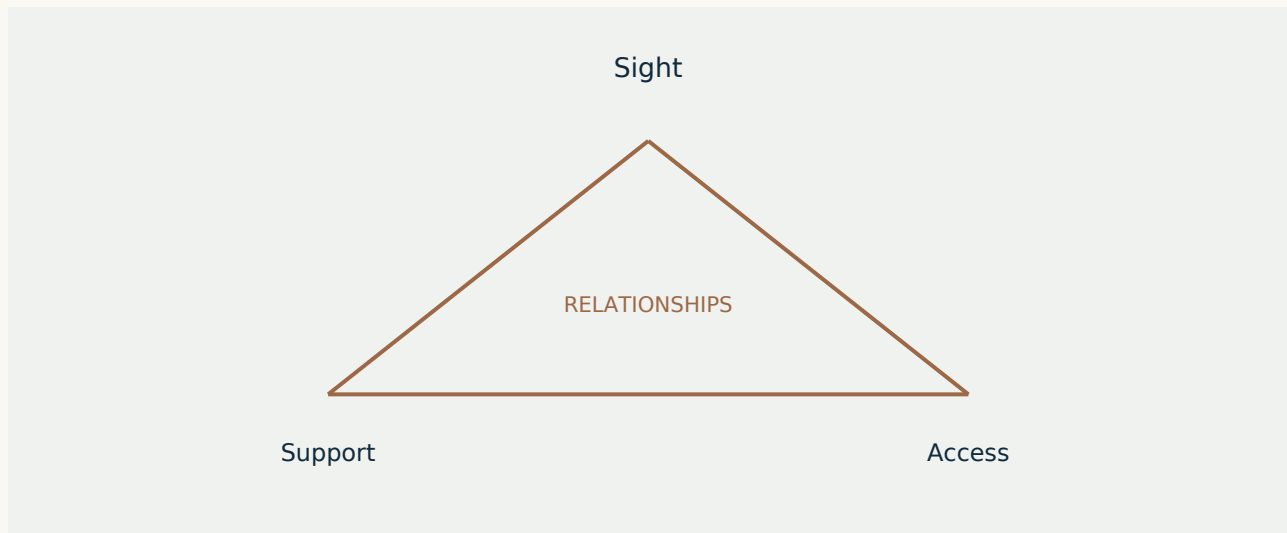


Source example of curette handling during middle-ear exposure. The grip is shown in its original procedural context.

Source figure 5. Harris T, Linder T. Incus and malleostapedotomy, stapedectomy, stapedotomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 02 / STUDY COMPANION

Visibility is part of instrument control



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Sight	The active tip and its immediate surroundings remain visible.
Support	A stable hand and specimen reduce unwanted excursions.
Access	The approach admits the instrument without hiding its contact point.

Discuss at the specimen

Why can an angled endoscope show a target that an instrument cannot safely reach?

Optical access and instrument access are different. The instrument shaft, tip, surrounding anatomy and the scope itself still occupy the working corridor.

Record

Record the setup change that improved visibility without increasing force.

CHAPTER 03

Orientation and surface anatomy

Construct a three dimensional map

A temporal bone should be oriented by several related features rather than a single prominence. Identify the external auditory canal, mastoid process, root of the zygoma and the remaining squamous surface. Establish superior and inferior, anterior and posterior, then relate the lateral view to the intracranial surface if it is preserved. The same structure can look unfamiliar when the bone is rotated, so practise reorienting after a deliberate change of view.

The external canal provides a useful central reference. Its posterior wall separates the canal from the mastoid field, while its superior region relates to the epitympanum. The temporal line is a surface guide to the superior mastoid region, not a guarantee of the exact position or thickness of the deeper roof. The spine of Henle may help orientation but varies in prominence. Its absence or poor definition requires other landmarks, not an assumption that the specimen is unusable.

Posteroinferiorly, examine the mastoid tip and, where accessible, the digastric groove. These become relevant when relating the inferior mastoid to the descending facial nerve and stylomastoid region. Anteriorly, note the relationship of the canal to the mandibular fossa. Preserve these features until their deeper relationships have been understood.

Relate surfaces to compartments

Think of the temporal bone as connected compartments with shared boundaries. The mastoid communicates with the epitympanum through the antral and adital region. The middle ear lies medial to the tympanic membrane. The inner ear is enclosed in dense otic-capsule bone. The internal auditory canal approaches the inner-ear and facial-nerve structures from the posterior cranial fossa. This arrangement explains why progress in one compartment can place a structure in another at risk.

Identify a boundary by its continuity and relationships. A small patch of smooth bone does not have a unique identity. During deeper work, relate it to the canal wall, roof, antral structures and known direction of dissection. Photograph the broad field before taking a close-up so that detailed images retain their context.

Examine the harvested bone critically

Specimen edges may remove normal landmarks or expose structures from an unusual direction. A cut surface can reveal the carotid canal, jugular region or internal auditory canal without reproducing the route used in surgery. Use this opportunity to understand relationships, but do not mistake a harvest window for a surgical corridor.

Look for fractures, missing cortical plates and previous drilling. Where a defect is present, inspect its margin before attributing it to natural dehiscence. A distinction between native anatomy and specimen damage is essential for later interpretation. If the cause cannot be established, record the uncertainty rather than assigning a diagnosis.

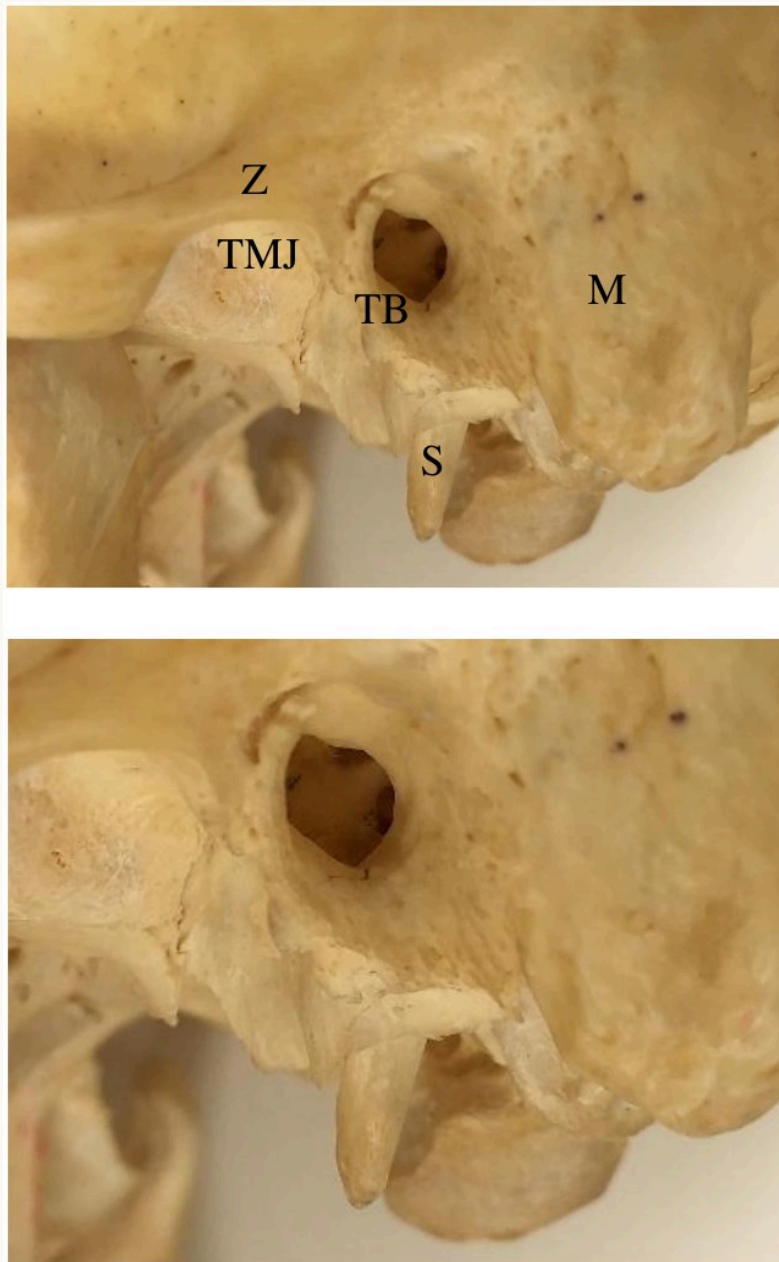
Build the map progressively

At the outset, locate the expected positions of structures that remain hidden. As the dissection progresses, revise that map using direct findings. Do not continue to rely on the original estimate when new evidence contradicts it. The relationship between surface landmarks and deep anatomy becomes most useful when it is repeatedly checked during exposure.

At completion of this chapter, the learner should be able to rotate the specimen, restore orientation and explain how the planned mastoid and middle-ear exercises relate to one another. The goal is a usable anatomical framework. Memorising a series of names without connecting their positions will not provide that framework when the view changes.

CHAPTER 03 / OPERATIVE PLATE 3.11

Lateral surface relationships

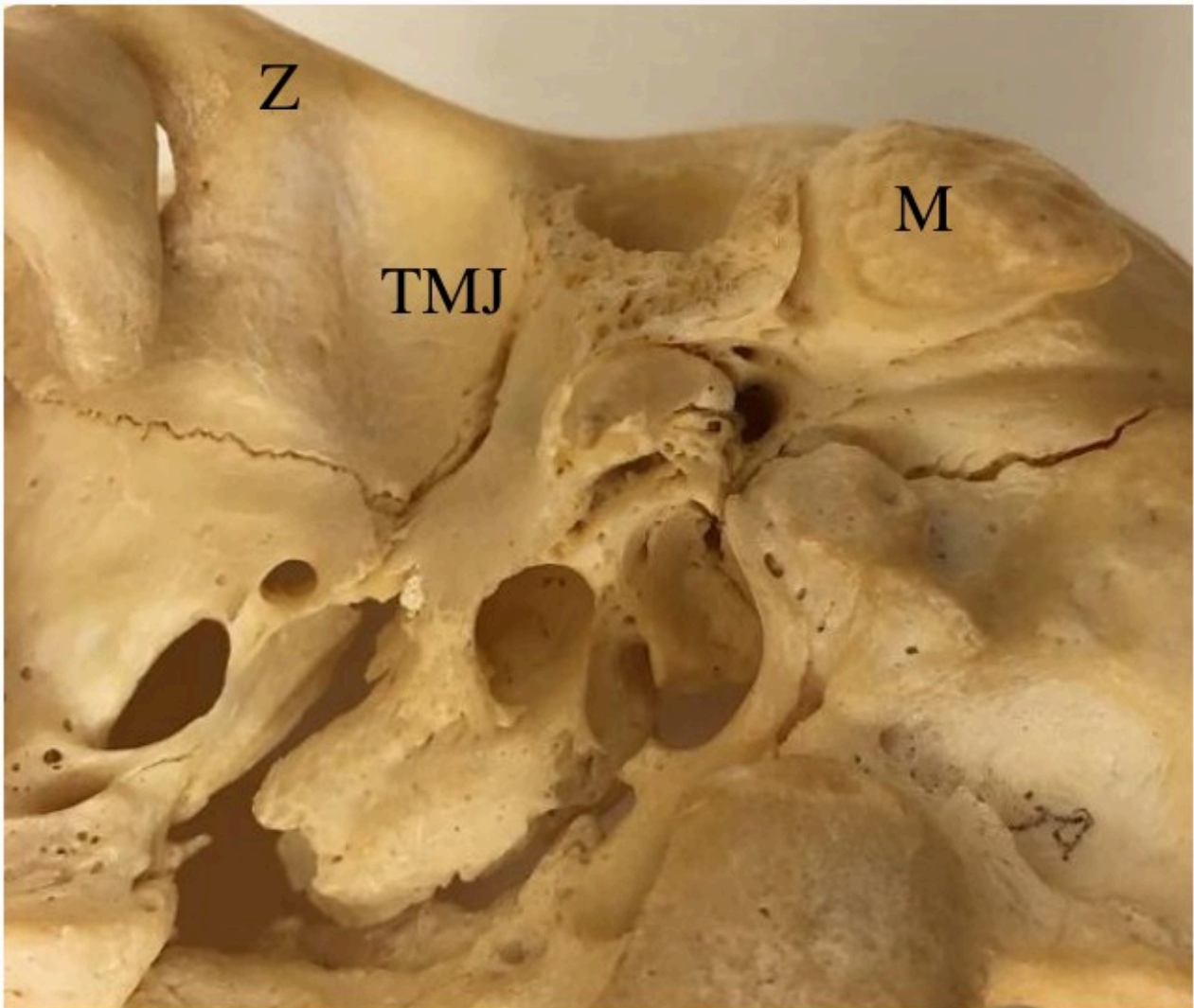


Two lateral specimen views relate the external canal to the zygoma (Z), mastoid (M), tympanic bone (TB), styloid (S) and temporomandibular joint (TMJ).

Source figure 1. Mathew R, Harris T, Patel P. Lateral temporal bone resection surgical technique (2019). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 03 / OPERATIVE PLATE 3.12

Inferior orientation

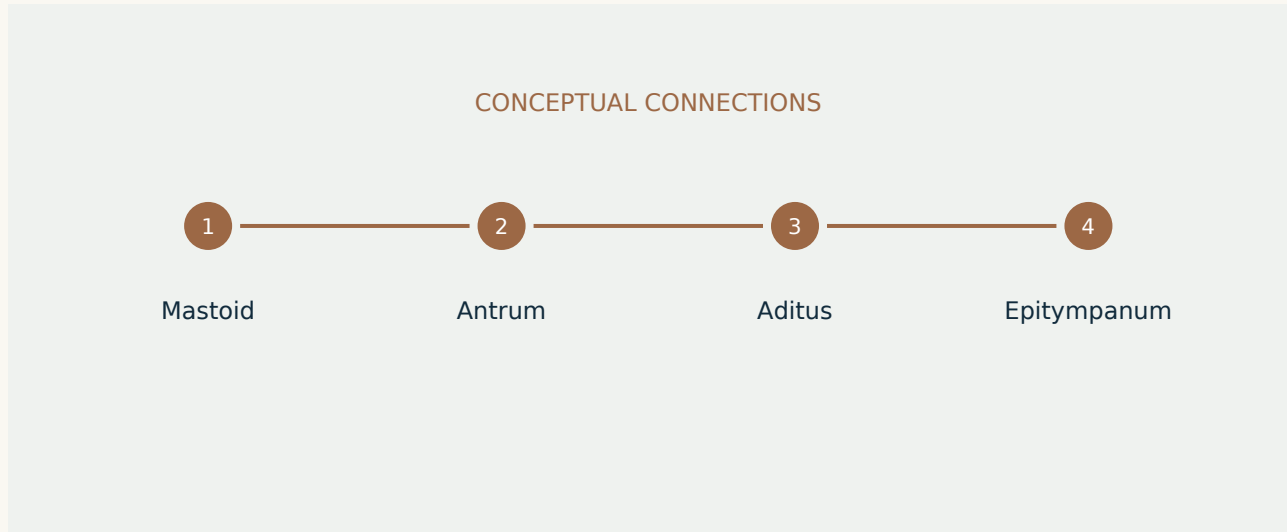


Inferior view of the external auditory canal and adjacent bone. This complements the lateral views without changing the specimen orientation.

Source figure 2. Mathew R, Harris T, Patel P. Lateral temporal bone resection surgical technique (2019). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 03 / STUDY COMPANION

Keep the compartments connected



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Lateral reference External canal and posterior canal wall orient the mastoid field.

Superior reference The roof must be related to deeper anatomy, not inferred from one surface line.

Deep reference The otic capsule and intracranial surfaces add a second perspective.

Discuss at the specimen

A smooth bony surface appears after rotation. Is texture enough to name it?

No. Restore the view using several established landmarks, then follow the surface's continuity and relationships. Texture alone is not a unique identifier.

Record

Show the same landmark in a broad view and a close view.

CHAPTER 04

Reading temporal bone imaging

Review the specimen in more than one plane

Where imaging of the actual specimen is available, verify its identity and side before using it. Examine thin-section bone-window images in axial and coronal planes, with additional reformats when needed. Follow a structure through adjacent sections rather than treating one image as a complete anatomical description. A teaching scan from another specimen may illustrate a relationship, but it does not establish the dimensions or variants of the bone on the bench.

Begin with the external canal and middle ear to orient the study. Trace the ossicular region, cochlea, vestibule and semicircular canals, then inspect the mastoid air-cell system and its boundaries. Relate the radiological planes to the microscope view by rotating the specimen or using an orientation drawing. Do not assume that the display's left side is the specimen's left side.

Read for the intended exposure

For mastoid dissection, assess the distribution of air cells, the contour of the tegmen and the position of the sigmoid sinus relative to the canal wall and labyrinth. Dense bone may provide fewer air-cell transitions to guide orientation. A low roof or an anteriorly positioned sinus can restrict the available field. These findings affect the approach to exposure; they are not measurements that authorise blind drilling.

For posterior tympanotomy and cochlear work, inspect the facial nerve course, cochlear configuration, round-window region and vascular anatomy. For inferior or petrous-apex routes, assess the jugular bulb, carotid canal and available aerated tracts. For internal auditory canal work, relate the canal to the cochlea, labyrinth and petrous surfaces. Describe the relevant anatomy before choosing a route.

Do not infer normal anatomy from a structure that is simply difficult to see. Small bony defects can be below the resolution of a particular acquisition, and thin bone may appear absent because of imaging limitations. If a suspected dehiscence would materially change the procedure, seek appropriate radiological review. A normal-looking scan does not replace direct anatomical caution.

Translate a finding into a practical expectation

A useful pre-dissection note links anatomy to the task. For example, a restricted region should prompt a discussion of exposure and instrument access, rather than a numerical declaration of safety. If a landmark is expected to be difficult to identify, decide what additional relationships will support recognition.

Distances measured on CT must be interpreted in the correct plane and within the individual specimen. They do not compensate for a change of drilling direction, an oblique working view or an inaccurately positioned instrument. Avoid teaching a single adult antrum depth as a universal endpoint. The purpose of measurement is to refine the anatomical plan, not to replace it.

Review imaging again when the field changes

Keep the study accessible during the exercise. When a finding differs from expectation, stop and compare the same region in more than one plane. Check whether the difference reflects orientation, incomplete exposure, specimen damage or genuine variation. Do not select a convenient CT slice merely because it resembles the current view.

After dissection, correlate the exposed structures with their pre-dissection images. This closes the learning loop between two-dimensional sections and three-dimensional anatomy. Record important discrepancies and the explanation established with the instructor. If the discrepancy remains unresolved, retain it as a documented question rather than silently revising the original interpretation.

CHAPTER 04 / OPERATIVE PLATE 4.11

Coronal CT correlation

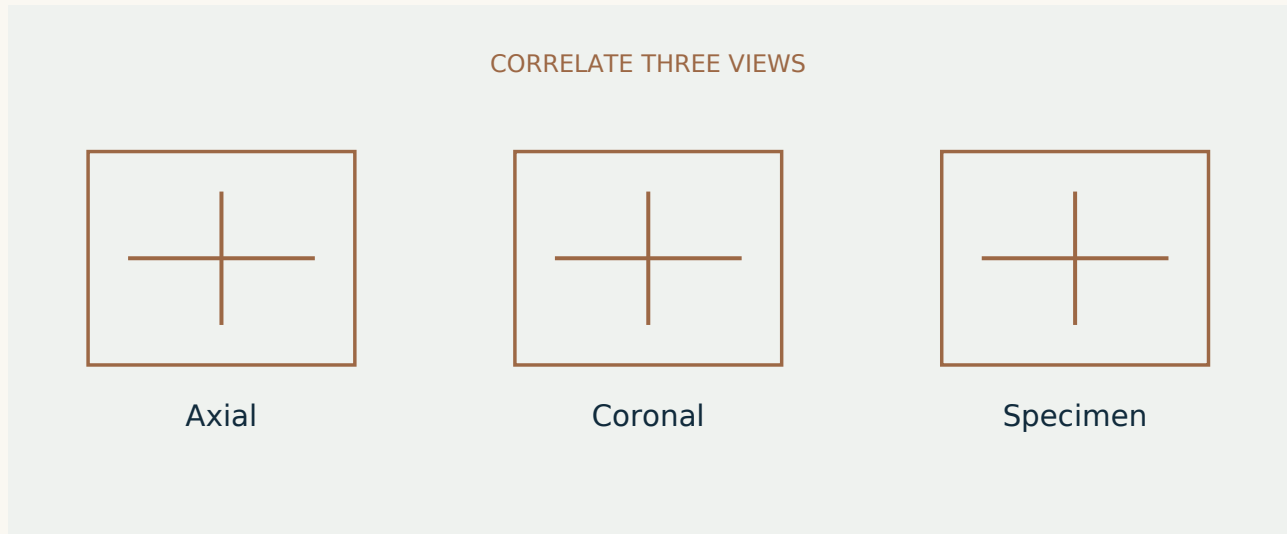


Published coronal CT used by the source to explain middle-ear access. Correlate the actual scan with the specimen; this single slice is not a complete preoperative assessment.

Source figure 3. Tarabichi M. Endoscopic cholesteatoma, tympanoplasty and middle ear surgery (2013). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 04 / STUDY COMPANION

Read a volume, not a single slice



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Identity	Confirm that the scan and side belong to this specimen.
Continuity	Trace a structure across adjacent sections and another plane.
Consequence	Translate a variant into an exposure question, not a blind drilling distance.

Discuss at the specimen

The CT appears to show an absent thin bony covering. What remains unresolved?

Apparent absence may reflect a true defect or acquisition and reconstruction limitations. Correlate planes and obtain appropriate review before relying on it.

Record

Write one imaging finding and the change it makes to the intended exercise.

CHAPTER 05

Transcanal exposure and the middle ear

Preserve the intact view

Examine the tympanic membrane and canal before raising a flap. Identify the malleus handle, umbo, pars tensa and pars flaccida where preservation permits. Note canal curvature, bony overhangs, membrane defects and any disruption from harvesting. A photograph of the intact view provides a reference for subsequent flap replacement and ossicular assessment.

Position the specimen so that the intended canal wall and annular region are visible. Select a speculum or other exposure appropriate to the anatomy without forcing it against the canal. If the view is inadequate, improve positioning and illumination before enlarging the access. Preserve sufficient canal skin and flap length for the planned reconstruction exercise.

Elevate the tympanomeatal flap

Under direct vision, incise and elevate the selected canal-skin flap in the instructor-demonstrated plane. Keep the instrument against bone and support the tissue rather than stretching it. As the annulus is approached, identify its position and elevate it carefully from the sulcus. The transition into the middle ear should be recognised, not achieved by an uncontrolled release of force.

Protect the chorda tympani as it comes into view. Avoid assuming that a delicate strand is expendable because its identity is uncertain. Separate the membrane and annulus with attention to their attachments and keep the flap moist and supported. The approach should expose the middle-ear structures without using the ossicles as a lever.

Survey the cavity systematically

Identify the promontory and the ossicular chain, then relate the oval-window and round-window regions to them. Inspect the tympanic facial-nerve region superior to the oval window, the pyramidal eminence and stapedius tendon posteriorly, and the cochleariform process with the tensor tympani tendon anteriorly. Examine the epitympanic, hypotympanic and protympanic directions as the view permits.

The posterior middle-ear recesses deserve specific attention because they may not be fully seen along a straight microscopic line of sight. Alter the view or use an endoscope when appropriate to demonstrate the difference between seeing a recess and reaching it safely. Do not pursue a hidden area with a hook whose tip cannot be observed.

Assess movement without damaging the chain

Inspect the joints and attachments before testing ossicular movement. Apply only gentle, controlled movement under supervision and observe how it is transmitted.

Fixation-related changes cannot be interpreted as normal live mechanics. Record any pre-existing dislocation or missing structure before further manipulation.

If ossicular removal is planned for a later exercise, first document the intact relationships. In particular, recognise how movement at the incus can be transmitted to the stapes. Joint separation should be deliberate and controlled rather than produced by pulling an ossicle free. Preserve the chain until the exercise requiring its removal has been agreed.

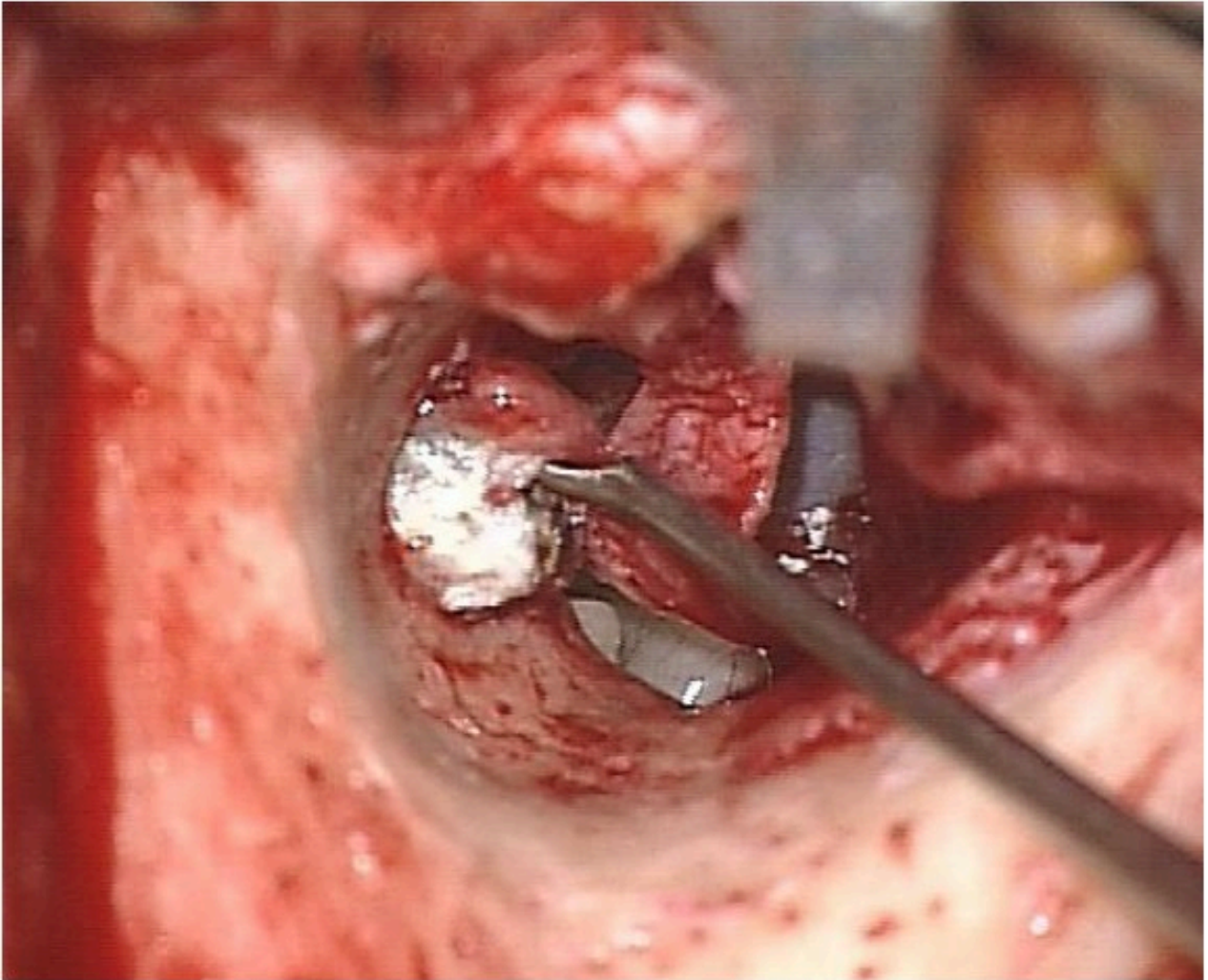
Complete the exposure

Replace the flap to assess its reach and position. Check the annulus, membrane, canal skin and chorda tympani for damage. A clean exposure with a torn flap is not equivalent to a preserved reconstructible approach. Record the limitation and discuss how the instrument movement or initial access contributed.

The chapter is complete when the learner can orient within the middle ear, explain the visible structures and replace the flap without undue tension. Further ossicular, stapes or posterior-recess work should follow a defined plan. The presence of a newly accessible structure is not itself an indication to manipulate it.

CHAPTER 05 / OPERATIVE PLATE 5.11

Tympanomeatal exposure

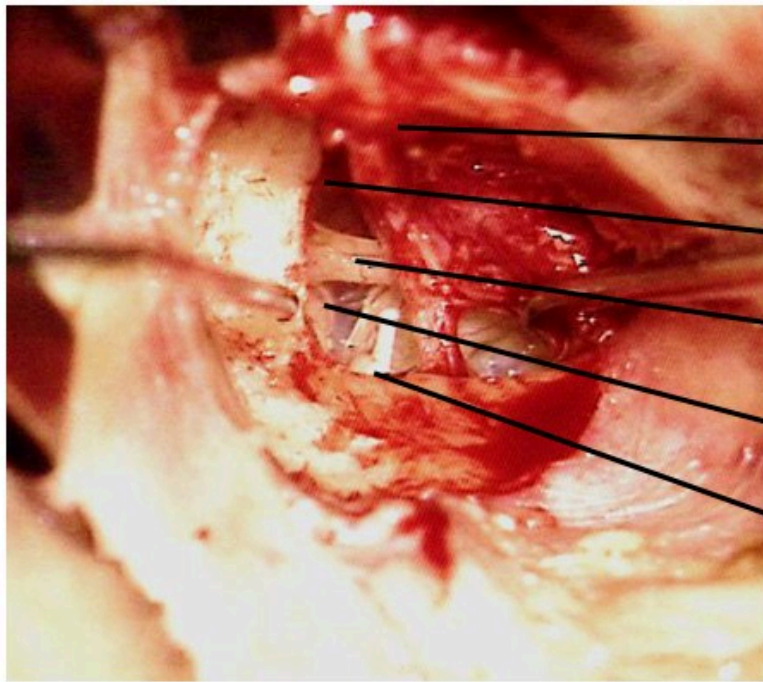


The source demonstrates flap elevation in the middle-ear approach. Preserve orientation to the canal wall and tympanic membrane throughout exposure.

Source figure 8. Harris T, Linder T. Mastoidectomy and Epitympanectomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 05 / OPERATIVE PLATE 5.12

The exposed middle ear



Malleus

Incudomalleal joint

Incus

VII n

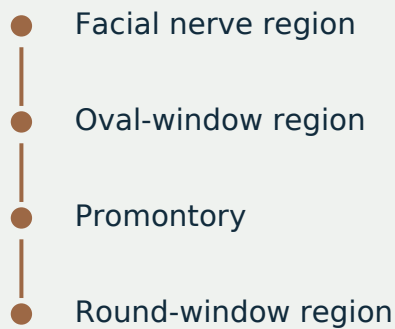
Pyramidal process

Labelled source view after exposure for stapes surgery. It identifies the chorda tympani, incus, stapes, tendon and facial-nerve region in this particular field.

Source figure 6. Harris T, Linder T. Incus and malleostapedotomy, stapedectomy, stapedotomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 05 / STUDY COMPANION

The medial wall has a working context

- 
- Facial nerve region
 - Oval-window region
 - Promontory
 - Round-window region

Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Before elevation	Document membrane, annulus, canal skin and the intact chain.
During survey	Relate windows and promontory to the tendons, nerve and recesses.
At closure	Replace the flap and inspect the structures used to gain access.

Discuss at the specimen

Why inspect the chain before manipulating it?

Pre-existing defects and fixation changes alter the meaning of later movement. The baseline distinguishes the specimen's starting condition from a change caused by dissection.

Record

Record which recess remained unseen from the chosen line of sight.

CHAPTER 06

Cortical mastoidectomy

Purpose and preparation

Cortical mastoidectomy develops the basic mastoid exposure while retaining the posterior canal wall. In the laboratory, it teaches progressive bone removal, saucerisation, recognition of the antral region and preservation of the major boundaries. Clinically, the extent of mastoid work depends on the indication and subsequent procedure; a laboratory demonstration should not be mistaken for a universal operation.

Review the surface orientation and available imaging, secure the specimen and establish a broad microscopic view. Identify the canal, temporal line, mastoid tip and relevant surface landmarks. Anticipate the superior and posterior boundaries without treating their surface projections as exact. Discuss which structures should be recognised and which should remain covered at the chosen endpoint.

Preparation of the working field

This chapter starts with the exposed bone. Postauricular incision, soft-tissue elevation, haemostasis and wound closure belong to the clinical approach and are not simulated by a bare specimen. Record the side, specimen condition and any previous dissection before beginning. Distinguish a pre-existing defect from one produced during this exercise.

Arrange the specimen so that the ear canal and mastoid surface can be related in the same view. Confirm that the holder remains stable when the hand rests on it. Adjust the microscope and chair before adopting a working grip; a comfortable posture at the surface can become an awkward reach when the cavity deepens. Repositioning is part of the technique.

Agree on the endpoint before drilling. For this chapter it is an intact posterior canal wall, a recognisable antral exposure and identified superior and posterior limits. Facial recess opening, deliberate facial-nerve skeletonisation and labyrinthine dissection are subsequent exercises. Photograph this starting view so that the final specimen can be compared with it.

PUBLIC EDITION NOTE

Figure 6.1 is omitted pending confirmation of its original source and reproduction rights.

The chapter text and separately credited source plates are retained. See the visual record on page 100.

Develop the cortical opening

Begin in a visible cortical field with a burr suited to controlled bulk removal. Keep the point of contact and surrounding surface in view. Develop the opening progressively rather than drilling a narrow tract towards an expected destination. Preserve the posterior canal wall and avoid accidental shortening of its superior or posterior margins.

As air cells appear, remove intervening bone in a way that maintains a broad, interpretable field. Do not follow an attractive cell tract without relating it to the established boundaries. Pneumatisation is variable; in a dense mastoid, the lack of obvious cells increases the need for repeated orientation. It does not justify advancing to a memorised depth.

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Figure 6.2 is omitted pending confirmation of its original source and reproduction rights.

The chapter text and separately credited source plates are retained. See the visual record on page 100.

Control of the burr

A cutting burr is useful for accessible cortical bone; a diamond burr allows more controlled refinement near important boundaries. Neither substitutes for a visible contact surface. Use irrigation, maintain a supported hand and avoid prolonged pressure at a single point. Choose a burr that can work in the available space without placing its shaft or opposite edge against a protected structure. [2]

Before a pass, identify the surface being removed and where the pass will finish. After it, clear the field and inspect what changed. This gives the learner a reproducible working rhythm without prescribing an arbitrary speed or number of strokes. A smaller burr is not the automatic answer to poor access: first decide whether the opening itself is restricting vision.

The supporting hand, suction and microscope must accommodate the changing depth. If the contact point disappears, stop the drill before correcting the view. Avoid using a moving burr as a pointer during teaching. Identify the intended surface with a stationary instrument, then resume the demonstration.

Saucerise while the cavity develops

Saucerisation creates a transition from the surface to the deeper cavity that permits vision and instrument access. Reduce overhanging edges as the exposure advances, while retaining structures required for orientation and the planned procedure. A deep cavity beneath a small opening can conceal the working surface and encourage instruments to approach obliquely.

Inspect the field from the actual working position. If a rim or shelf blocks the view, decide whether specimen rotation, microscope adjustment or further bone work is required. Do not remove a boundary merely because it prevents the cavity from resembling a demonstration specimen. The aim is adequate exposure within the chosen limits.

Maintain irrigation and suction so that the bone surface remains readable. Pause to clear retained debris. Distinguish material that can be washed away from a genuine bony plate. Where the surface becomes thin or its identity uncertain, reduce the aggressiveness of the work and establish the relationship before proceeding.

PUBLIC EDITION NOTE

Figure 6.3 is omitted pending confirmation of its original source and reproduction rights.

The chapter text and separately credited source plates are retained. See the visual record on page 100.

Establish the superior and posterior limits

The tegmen region defines the superior relationship of the mastoid cavity to the middle cranial fossa. The sigmoid sinus contributes to the posterior limit. Their contours vary, and a protective bony covering should be maintained as appropriate to the exercise. Colour alone is not a reliable requirement for recognising either boundary.

Follow a recognisable boundary as a continuous structure rather than identifying isolated patches. If the roof descends or the posterior limit approaches the working field, reconsider access before continuing medially. The available space is defined by the specimen, not by the desired dimensions of the cavity.

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Figure 6.4 is omitted pending confirmation of its original source and reproduction rights.

The chapter text and separately credited source plates are retained. See the visual record on page 100.

Approach to the antrum

The superior route provides a continuous anatomical reference as the exposure advances anteromedially towards the antral region. Avoid a low search for the antrum, which brings the dissection towards the facial nerve. The lateral semicircular canal prominence and the body and short process of the incus help establish the deeper orientation. Near the ossicles, direct bone-removal movements away from the chain and avoid drill contact with it. [2]

At this transition, slow the demonstration enough for the learner to distinguish newly visible structures from residual cell partitions. Identify the expected landmark in the specimen before attaching its label to a photograph. An instructor's finger on a screen cannot establish the anatomy if the image itself omits the surrounding relationships.

Recognise the antral region

Progress towards the antrum through a field whose orientation remains established. Relate the antral space to the lateral semicircular canal prominence and incus region as they become recognisable. Do not allow the burr to contact the ossicular chain. Distinguish identification of the antrum from further attic or posterior tympanotomy work, which have separate objectives.

Körner's septum can create a misleading partition: superficial cells may resemble the antrum and a dense septum may be mistaken for its deeper limit. The response is to reassess the roof, canal wall, available imaging and related landmarks. The absence of an expected structure does not establish that an unfamiliar plate can safely be crossed.

When the specimen differs from the demonstration

An air-cell pattern is not a template for the next bone. Compare the actual field with the available imaging and the established canal wall, roof and posterior boundary. Keep a distinction between what has been identified, what is expected and what remains uncertain. Record the uncertainty before additional drilling obscures the evidence.

If a partition is suspected to be Körner's septum, document that as a provisional interpretation until its relationships have been checked. Do not label every unexpectedly dense plate as a septum. Similarly, when a cavity looks smaller than the example, reassess the boundaries before trying to enlarge it to match the picture. The reference specimen demonstrates relationships, not compulsory dimensions.

For teaching, compare two specimens only after completing the orientation of each. Keep the viewing angle and scale comparable. Ask the learner to describe the changed exposure and the resulting adjustment in access. This develops an account of anatomical variation that can be checked against the specimen rather than a list memorised apart from it.

Refine the cavity without extending its purpose

Review the peripheral regions for obstructing overhangs and retained cell groups relevant to the exercise. Superiorly, inspect the roof and antral relationship. Posteriorly, relate the cavity to the sinus plate. Inferiorly, understand the mastoid tip and digastric-ridge region before any extension. Anteriorly, preserve the canal wall and retain awareness of the facial nerve's deeper course.

A cortical mastoidectomy does not require routine unroofing of the facial nerve, opening of the labyrinth or removal of the ossicles. These structures are protected while their

positions are understood. If an advanced exercise is planned, record the completed basic exposure before altering it.

Review the exposure systematically

Inspect the final cavity in the same order each time: canal wall, roof, posterior boundary, antral region and inferior extent. At each area, describe the structure preserved, the visibility achieved and any unintended alteration. This order is an assessment method for the chapter, not a validated scoring instrument.

Separate three problems that can look similar in a photograph. An obscured structure needs a better view; an unidentified structure needs anatomical reassessment; an injured structure needs recognition and review. Additional drilling is not an appropriate response to all three. The record should explain which problem was present and why the next action was chosen.

If there is a suspected breach or ossicular injury in the laboratory, stop, document the field and obtain direct review before continuing. A cadaver does not reproduce bleeding, facial function or hearing. A dry, apparently clean field therefore cannot establish that the equivalent manoeuvre would have been harmless in a patient. Clinical complication management requires its own supervised protocol.

Common errors and completion

A narrow deep cavity suggests that access has lagged behind depth. Unexplained smooth bone suggests a problem of identification. A displaced incus suggests transmitted mechanical injury. An unintended plate defect requires immediate recognition and instructor review, even if the remainder of the cavity appears satisfactory. Do not continue simply to make an imperfect result look finished.

At completion, demonstrate the preserved canal wall, superior and posterior boundaries and recognised antral relationships. Clear debris, inspect the ossicular region and account for any unintended changes. The instructor should review both the final anatomy and how it was reached. A sound exercise leaves a recognisable, appropriately bounded exposure and a documented basis for the next dissection.

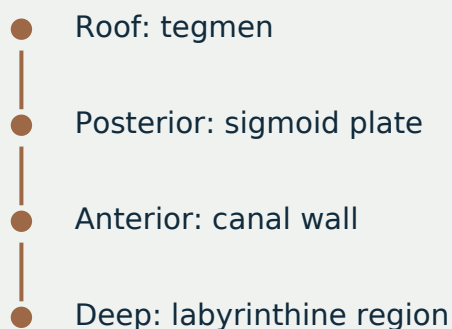
Transfer to the next chapter

Before extending the dissection, save a final overview and record whether the intended endpoint was achieved. Name any deviation from the planned sequence and explain its anatomical reason. Preserve a separate record of unintended damage rather than allowing later dissection to conceal it.

The next chapter develops the antrum, aditus and epitympanum. Its opening view should be the completed field from this chapter. This continuity lets the reader see how a new operative objective changes the exposure without losing the anatomy already established.

CHAPTER 06 / STUDY COMPANION

A cavity must remain orientated

- 
- Roof: tegmen
 - Posterior: sigmoid plate
 - Anterior: canal wall
 - Deep: labyrinthine region

Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Exposure	A broad readable field is more informative than an unobserved deep hole.
-----------------	--

Recognition	Use continuity and several landmarks when an air space appears.
--------------------	---

Preservation	Document the status of roof, sinus covering, canal wall and labyrinth.
---------------------	--

Discuss at the specimen

Why is the first large air cell not automatically the antrum?

Pneumatisation and septa vary. An air space requires corroboration from its position and neighbouring anatomy before it is identified as the antrum.

Record

Describe the exposed space using landmarks rather than depth alone.

CHAPTER 07

The antrum, aditus and epitympanum

Connect the mastoid and middle ear

After cortical mastoidectomy, study the antrum as a transition between the mastoid and epitympanic regions. Identify the lateral semicircular canal prominence and the short process of the incus where the specimen permits. Trace the direction of communication through the aditus without placing an instrument blindly into the passage. The relationship is easier to understand when the mastoid and transcanal views are compared before either is extended.

The epitympanum contains the malleus head and incus body with their attachments. Its inferior relationships include the rest of the ossicular chain, while its roof relates to the middle cranial fossa. Exposure must account for these connected structures. Movement applied to the incus body may be transmitted to the stapes even when the stapes is outside the mastoid view.

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Figure 7.1 is omitted pending confirmation of its original source and reproduction rights.

The chapter text and separately credited source plates are retained. See the visual record on page 100.

Establish continuity before enlarging the exposure

Begin with the completed cortical mastoidectomy from Chapter 6. Remove loose debris and recover the orientation before changing the field. Record whether the posterior canal wall and ossicular chain are intact. An injury or deliberate alteration made earlier changes the starting anatomy and must be carried forward in the record.

Compare the two available views without moving an instrument through the aditus to prove that they communicate. A photograph from each route, labelled for side and direction, is more useful than an unlabelled close-up. Identify a shared landmark and describe the direction of the unseen space. Repeat this comparison after each deliberate extension.

The first demonstration should preserve the chain. This retains a reference against which a later destructive dissection can be understood. If the specimen has already lost an ossicle, describe the actual residual anatomy; do not present it as an intact-chain example.

Define the intended attic exposure

Decide whether the exercise is limited to inspection or includes atticotomy, ossicular removal or a wider epitympanectomy. Record the starting chain before removing bone around it. Preserve the incus buttress when it remains useful for orientation and support. Avoid treating every obstructing structure as disposable simply because a wider view is possible.

Develop the exposure under direct vision, protecting the ossicles from drill contact. Bone removal should expose the intended region while maintaining awareness of the tegmen, canal and tympanic facial-nerve area. Use specimen rotation or a different viewing route when this improves understanding without unnecessary tissue removal. The endpoint is determined by the planned dissection, not by the need to demonstrate every recess through one opening.

Distinguish the extent of bone removal

Terminology varies. In the Harris and Linder atlas, epitympanotomy is a limited opening of the lateral attic wall with the ossicles retained; their epitympanectomy includes removal of the incus and malleus head and wider clearance. Use a descriptive operative record as well as the procedure name. State which wall was altered, which ossicles were retained and what space was exposed. [2]

For this chapter, complete limited inspection first. Treat ossicular removal and wider exposure as a separate, explicitly planned extension. Do not alternate between these endpoints midway through the exercise without recording the change.

Examine the hidden compartments

Once the posterior epitympanic relationships are understood, inspect the anterior epitympanic direction. Small folds and bony partitions may influence communication and visibility. Their appearance varies with preservation and prior dissection. A broad view of the attic does not guarantee inspection of every anterior or medial recess.

Use an endoscope, when available and appropriate, to compare the view around these corners with the microscope's view. Keep a record of which structures are seen from each route. This demonstrates why an exposed cavity and an inspected cavity are not always equivalent. It also prevents the learner from interpreting an inaccessible recess as absent anatomy.

Compare the viewing routes

A microscope view and an endoscopic view answer different questions about the same space. An angled view can reveal a recess beyond the direct line of sight, but visibility does not demonstrate that a working instrument can reach it with control. Before enlarging the opening, distinguish a limitation of viewing direction from a limitation of instrument access.

Endoscopic literature describes how folds and ligaments partition the attic and affect its communication with neighbouring spaces. Tensor-fold configuration varies; an anterior space should therefore be inspected as an individual arrangement rather than assumed to follow a single diagram. [10] Preserve these delicate structures during the first examination if they remain intact in the specimen.

In the teaching record, name the route used for each observation. When a recess remains unseen, record "not visualised" rather than "normal" or "absent". This distinction is especially important in a preserved specimen where tissue condition can limit interpretation.

Handle the ossicles in a planned sequence

If removal of the incus or malleus head forms part of the exercise, demonstrate the intact joints first. Separate the relevant joint under vision before mobilising the ossicle. Identify and release remaining attachments deliberately. Do not lever an ossicle against the footplate or rely on a sudden movement to detach it.

Preserve removed ossicles for anatomical examination and reconstruction practice. Note damage to their processes or articular surfaces. After removal, compare the newly visible space with the original view and identify which landmark has been lost. The exposure has improved, but the orientation strategy must now change because the chain no longer provides the same reference.

Make ossicular removal a separate demonstration

Before mobilising the incus, establish the incudostapedial relationship from a view that actually exposes it. The atlas describes division of this joint to limit transmitted movement during subsequent epitympanic work. [2] A concealed joint should not be presumed separated because the incus appears mobile.

The laboratory sequence should make the change in anatomy visible: document the intact chain, demonstrate the planned disconnection under direct view, then show the field after the intended ossicle has been removed. Pause between these stages. The images must not skip directly from an intact attic to an empty space while leaving the most consequential manipulation unexplained.

Removing the malleus head is a further planned extension, not an automatic consequence of removing the incus. Describe the part retained and the attachments affected. A detailed instrument-specific demonstration must be agreed with the supervising otologist before this passage becomes a definitive operative instruction.

Place each removed ossicle in a labelled container. Record which side it came from and whether it was intact before removal. If it breaks during extraction, preserve the pieces and the observation. A reconstruction exercise needs an accurate account of the available material.

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Reorient after the landmarks change

After ossicular removal, compare the new field with the starting photograph. The larger opening should now be described using the boundaries that remain. Do not continue to use the former position of a mobile or removed ossicle as though it were still a fixed landmark.

Review the roof, canal wall and medial relationships before further bone work. Anterior extension demands particular care because the visible space can expand while the distinction between its boundary and a neighbouring structure becomes less obvious. Further removal of anterior partitions is an advanced extension; it is not required merely to demonstrate that an anterior recess exists.

Variations and common errors

A low tegmen, dense bone or a narrow attic may restrict the exposure. Accept the specimen's constraints and clarify the planned route with the instructor. Unexpected soft tissue, granulation-like material or an eroded region in a harvested specimen cannot be assigned a clinical diagnosis by appearance alone. Preserve and document it when relevant to the learning objective.

Common errors include drilling onto the ossicles, confusing a limited view with a completed inspection and continuing after the chain has been destabilised without acknowledging the change. At completion, demonstrate the antrum, aditus and exposed epitympanic region from both available directions. State what remains preserved, what was deliberately removed and which recesses remain incompletely visualised.

Describe the final exposure

The final description should allow another surgeon to reconstruct the extent of the dissection without relying on its title. Record the side, viewing routes, retained canal wall, condition of the chain, deliberate bone removal and any incompletely inspected recesses. Distinguish observations from interpretations.

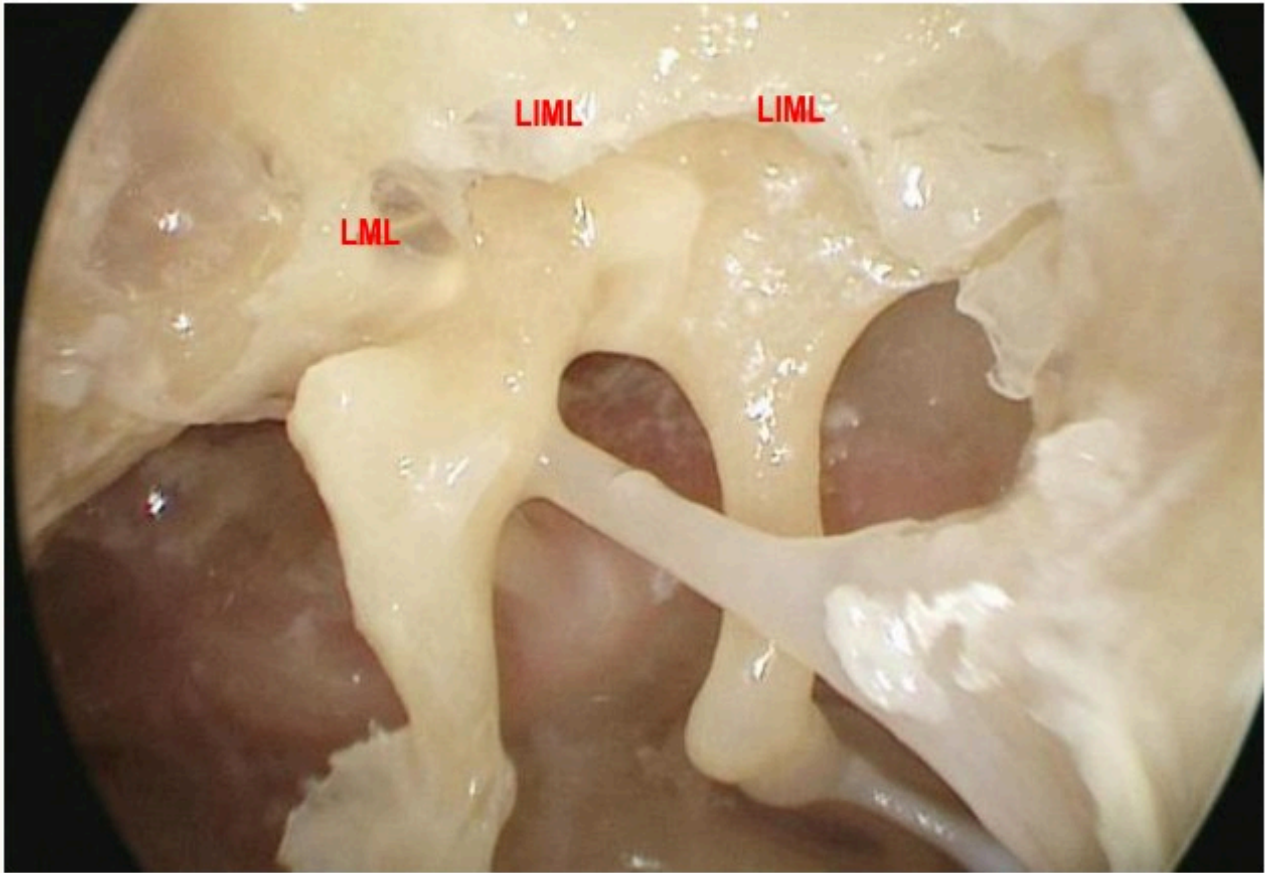
A specimen may demonstrate the intended anatomy despite a technical error. Record both. Conversely, a neat photograph may conceal an incompletely examined space. Assessment should therefore include the sequence and the final exposure, with direct review of the specimen wherever possible.

Transition to posterior tympanotomy

Save the completed attic exposure before beginning Chapter 8. Posterior tympanotomy introduces a different corridor and a new set of boundaries. A satisfactory view through the aditus does not establish that the facial recess has been identified. Begin that exercise with its own orientation and endpoint.

CHAPTER 07 / OPERATIVE PLATE 7.11

Attic before alteration

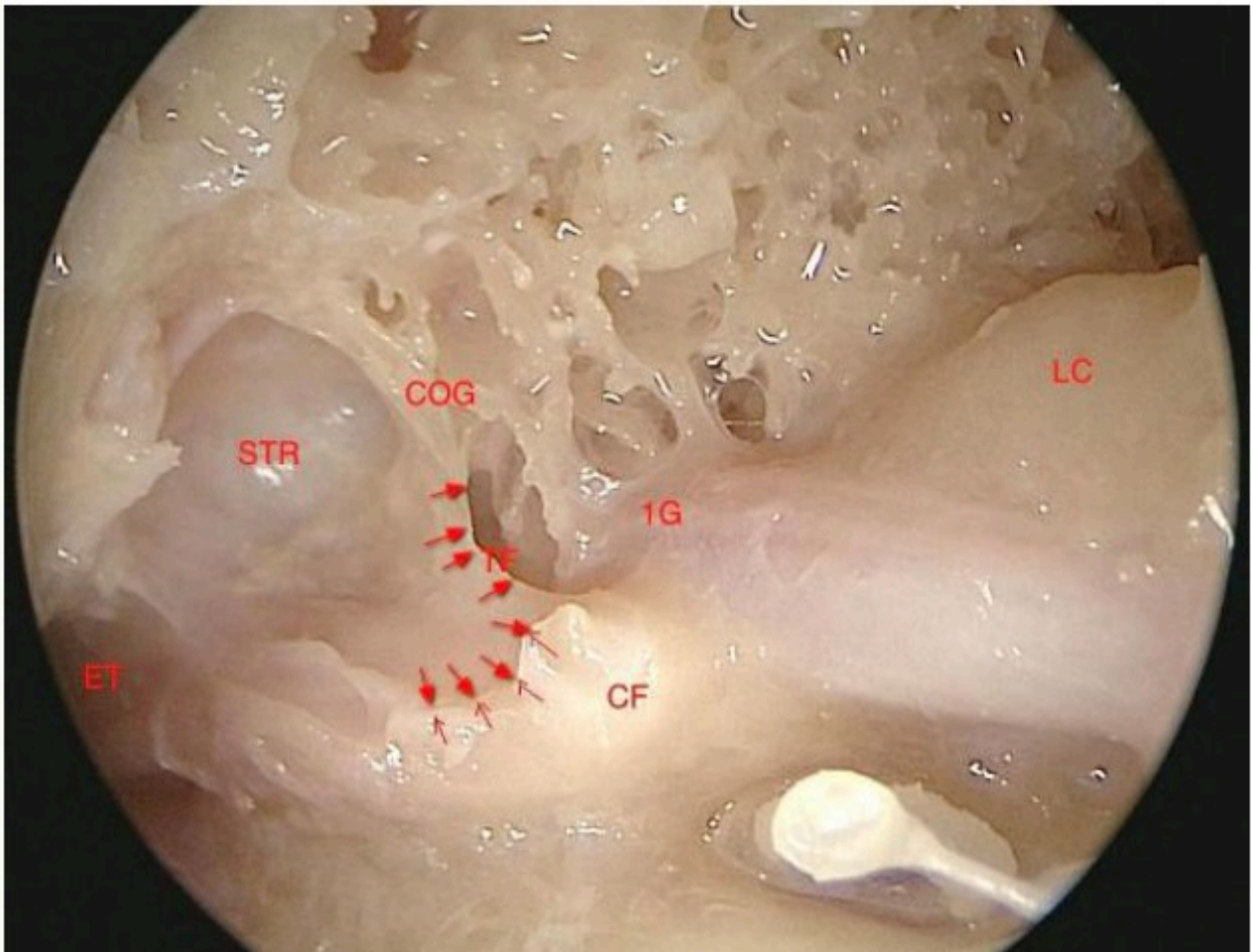


Endoscopic attic view with the original ligamentous and ossicular relationships still present. Compare with the deliberately altered view on the next plate.

Source figure 10. Tarabichi M. Endoscopic cholesteatoma, tympanoplasty and middle ear surgery (2013). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 07 / OPERATIVE PLATE 7.12

Anterior attic after exposure

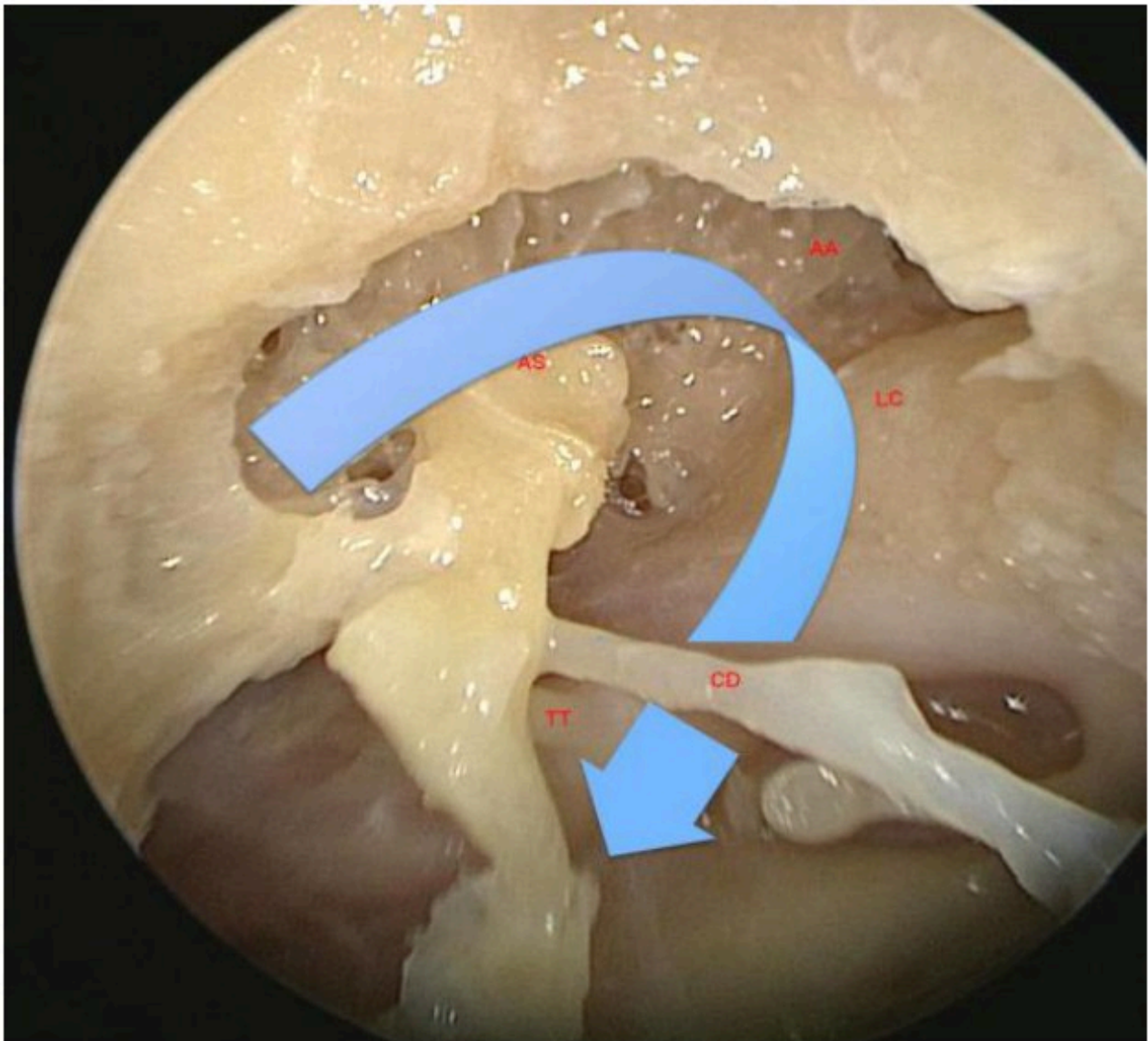


Anterior attic relationships after the source dissection has removed obstructing structures. This is an altered exposure, not the normal untouched middle ear.

Source figure 14. Tarabichi M. Endoscopic cholesteatoma, tympanoplasty and middle ear surgery (2013). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 07 / OPERATIVE PLATE 7.13

After incus removal

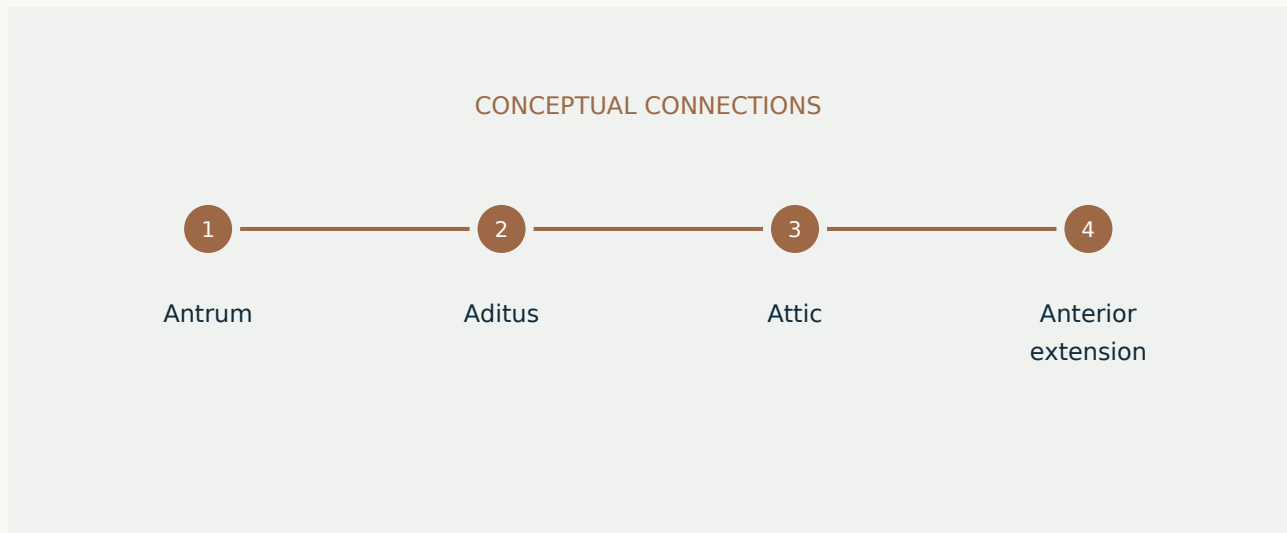


Source view following incus removal. The changed field must be interpreted using remaining anatomical references rather than the absent ossicle.

Source figure 18. Tarabichi M. Endoscopic cholesteatoma, tympanoplasty and middle ear surgery (2013). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 07 / STUDY COMPANION

Changing a landmark changes the map



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Starting view	Document the incus and surrounding reference structures.
Extension	State what additional space the new exposure actually reveals.
After alteration	Reorient deliberately if an ossicle or other familiar landmark is removed.

Discuss at the specimen

Does a view of the incus establish a complete anterior attic exposure?

No. A visible landmark establishes a local relationship; it does not prove that every recess beyond it is exposed. Name the limits of the actual view.

Record

Record the retained reference that replaced any deliberately removed landmark.

CHAPTER 08

The facial recess and posterior tympanotomy

Establish the corridor before opening it

Posterior tympanotomy provides a transmastoid route to the middle ear through the facial recess. The essential relationships are the mastoid segment of the facial nerve medially, chorda tympani laterally and the incus buttress superiorly. Their spacing and course determine the available corridor. [3] A remembered triangular shape is only a starting model; the actual specimen must establish its boundaries.

Complete a suitable mastoid exposure before attempting the recess. Inspect the incus region, lateral canal prominence and posterior canal wall. Relate the anticipated descending facial nerve to the surrounding anatomy. The objective is to open a defined interval while preserving its neural boundaries, not to find the middle ear by drilling an estimated hole.

Prepare a view that allows controlled work

Position the specimen so that the intended route can be seen along its depth. Select magnification and a burr appropriate to the small working field. Use irrigation and controlled movements, and retain a protective covering over the facial nerve wherever the exercise permits. The suction and burr should not compete for the same space or obscure each other's contact points.

Identify the chorda tympani and facial-nerve boundaries sufficiently to understand the interval before enlarging it. Do not assume that the nerve will announce itself by a characteristic colour. The bony canal and adjacent cells may vary in appearance, and specimen preservation can change the tissue beneath them.

Develop the posterior tympanotomy

Thin the bone within the established interval incrementally, maintaining the relevant boundaries in view. As the middle ear is entered, recognise the change in space and reassess the instrument trajectory. A burr that was safe within bone can become hazardous when a deeper cavity opens beneath it.

Enlarge the opening only as required for the planned middle-ear view. Preserve the incus buttress and avoid contacting the incus, stapes or tympanic membrane. Inspect the corridor after each meaningful enlargement. A useful opening provides both vision and an appropriate instrument path; an enlarged opening with an injured chorda or exposed facial nerve is a different result and must be recorded as such.

Relate the new view to the transcanal view

Identify the middle-ear structures visible through the recess and compare them with Chapter 5. The promontory, stapes region and round-window direction appear from a different perspective. Rotate or adjust the view rather than assuming that the familiar transcanal arrangement will present identically through the mastoid.

If an intended target cannot be seen, review the line of sight and the limits of the opening. Do not automatically enlarge towards a neural boundary. The problem may be the approach angle or a bony overhang beyond the recess. A discussion of alternative views is part of learning the corridor.

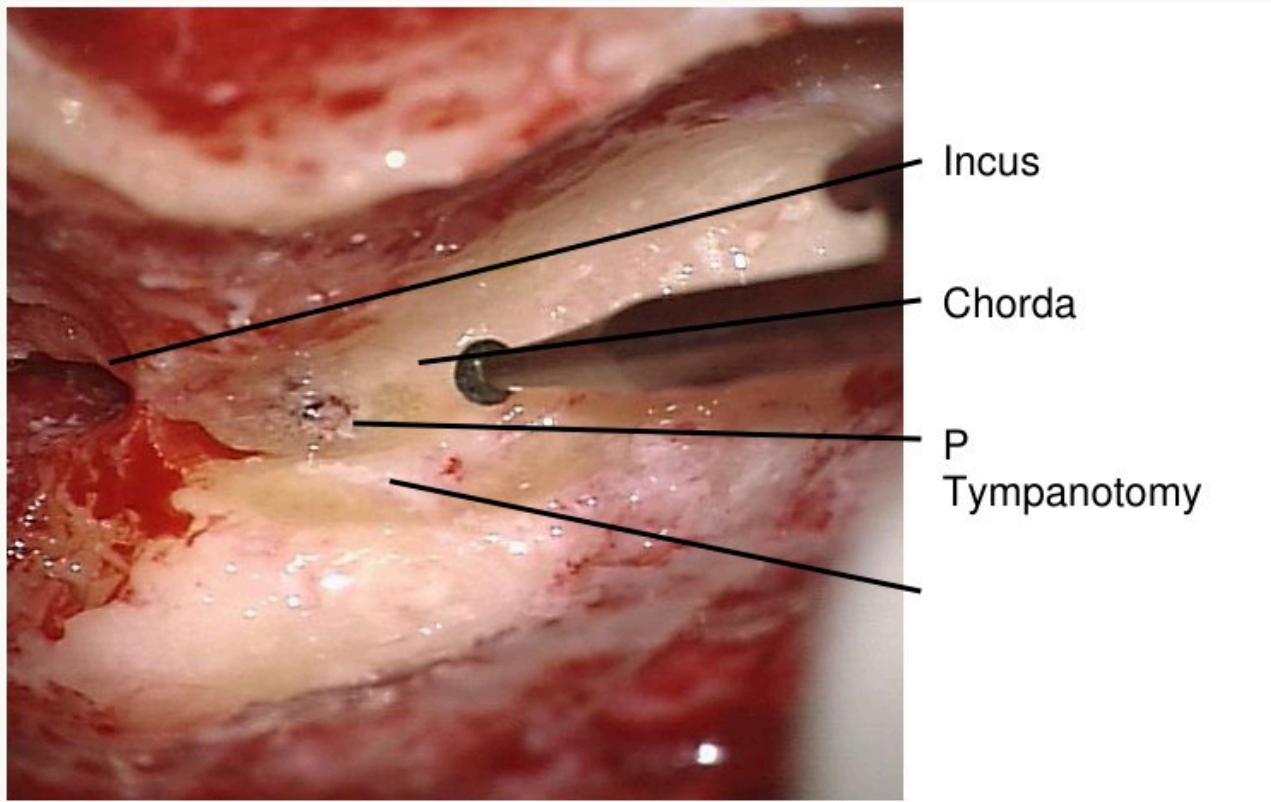
Restricted anatomy and completion

A narrow recess, unusual nerve course or damaged chorda makes the exercise more demanding. Where the boundaries cannot be established confidently, stop and obtain instructor review. The inability to create the expected opening should be described accurately rather than concealed by sacrificing a boundary.

Inspect the facial nerve covering, chorda tympani, incus buttress and ossicular chain at completion. Document the field visible through the opening and whether an instrument can be introduced under continuous vision. If cochlear work follows, record this intact stage first. Subsequent drilling around the round-window region must not obscure whether the recess itself was developed without injury.

CHAPTER 08 / OPERATIVE PLATE 8.11

Posterior tympanotomy

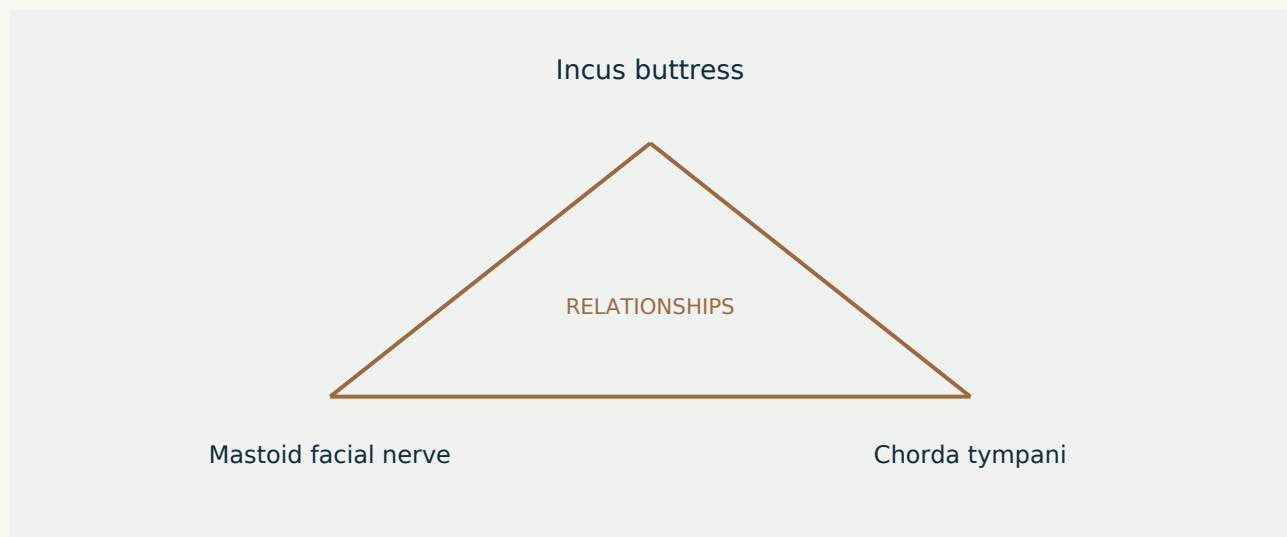


Labelled facial-recess exposure from the operative atlas. Original labels and leader lines are retained; the photograph does not define a universal safe corridor width.

Source figure 20. Harris T, Linder T. Mastoidectomy and Epitympanectomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 08 / STUDY COMPANION

Three boundaries, one corridor



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Superior	The incus buttress forms the superior reference.
Medial	The mastoid facial-nerve boundary constrains the opening.
Lateral	The chorda tympani boundary constrains the opposite side.

Discuss at the specimen

The target is not visible through the recess. Must the opening become wider?

Not necessarily. Reconsider the viewing angle, downstream overhang and individual anatomy before extending towards a neural boundary.

Record

Record both the visible target and whether an instrument can reach it under vision.

CHAPTER 09

The round window and cochlear implant corridor

Understand the target

The round-window niche and the round-window membrane are different structures. A view of the bony niche does not establish that the entire membrane is exposed or that the planned insertion trajectory is suitable. Begin by orienting within the middle ear through the available transcanal and posterior tympanotomy views. Relate the niche to the promontory and surrounding anatomy before removing an overhang.

Clinical cochlear implantation combines surgical exposure with audiological selection, imaging, device selection, rehabilitation and long-term follow-up. This chapter addresses the laboratory corridor and principles of atraumatic access. Device-specific electrode handling, insertion tools and fixation must follow the current manufacturer's instructions and specialist supervision. [4]

Prepare the approach

Review the available imaging for cochlear anatomy, ossification, facial-nerve variation and vascular relationships. A normal-looking surface does not establish normal intracochlear anatomy. In a specimen, document any pre-existing opening or missing membrane before beginning. Do not use an already damaged cochlea to judge whether an access was atraumatic.

Develop the mastoid and facial recess exposure needed for the planned view. Protect the ossicles and neural boundaries throughout. Adjust the specimen so that the target can be observed along a useful approach rather than from a tangential angle. If the membrane cannot be identified confidently, improve orientation and seek guidance before extending the dissection.

Expose the niche deliberately

Remove only the bone needed to understand and expose the intended entry region, using a controlled technique that avoids contact with the membrane. Keep bone dust and debris away from the cochlear opening. Reassess the view frequently: the last layer of an overhang may conceal a membrane that becomes vulnerable as soon as the bone is removed.

Distinguish exposure of the round window from creating a separate cochleostomy. These approaches are not interchangeable labels for any opening on the promontory. Selection depends on anatomy, the electrode and the operative plan. In the laboratory, the instructor should identify the intended route and the structure entered before an insertion

exercise begins.

Practise the insertion path

Use an appropriate training electrode or approved demonstration system. Establish an approach that permits controlled handling without forcing the array against the margin of the opening. Advance only according to the training device instructions and under direct supervision. Resistance should prompt a pause and reassessment of alignment and anatomy, not increased force.

The external appearance of insertion cannot prove the absence of intracochlear trauma. A completed training insertion may require subsequent imaging or destructive inspection to establish its course. If the cochlea is opened for this assessment, record that it is a separate destructive stage. Do not claim scala placement or hearing preservation from a smooth-looking insertion alone.

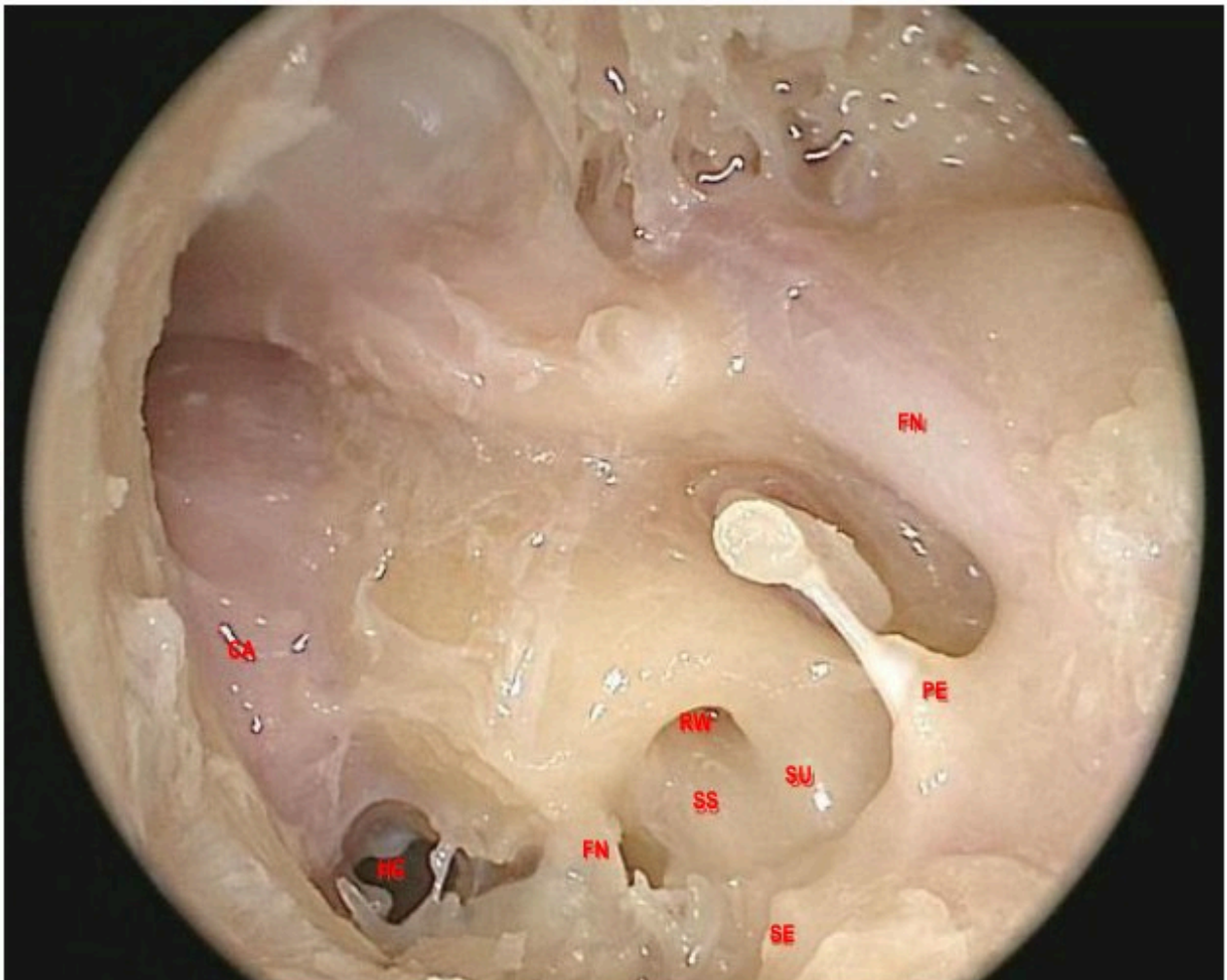
Review the complete corridor

Assess the mastoid, facial recess, niche and approach trajectory together. A well-exposed membrane does not compensate for a narrow or unstable instrument path. Conversely, a generous mastoid does not guarantee a useful view of the target. Review how each part of the exposure contributed to the final route.

Record the device used, the route, any resistance, any visible damage and the method used to assess the result. In clinical practice, electrophysiology and imaging provide information that complements the surgical view; they do not erase an observed technical concern. Laboratory success should be described as the achievement actually demonstrated, not as an assumed patient outcome.

CHAPTER 09 / OPERATIVE PLATE 9.11

Round-window neighbourhood

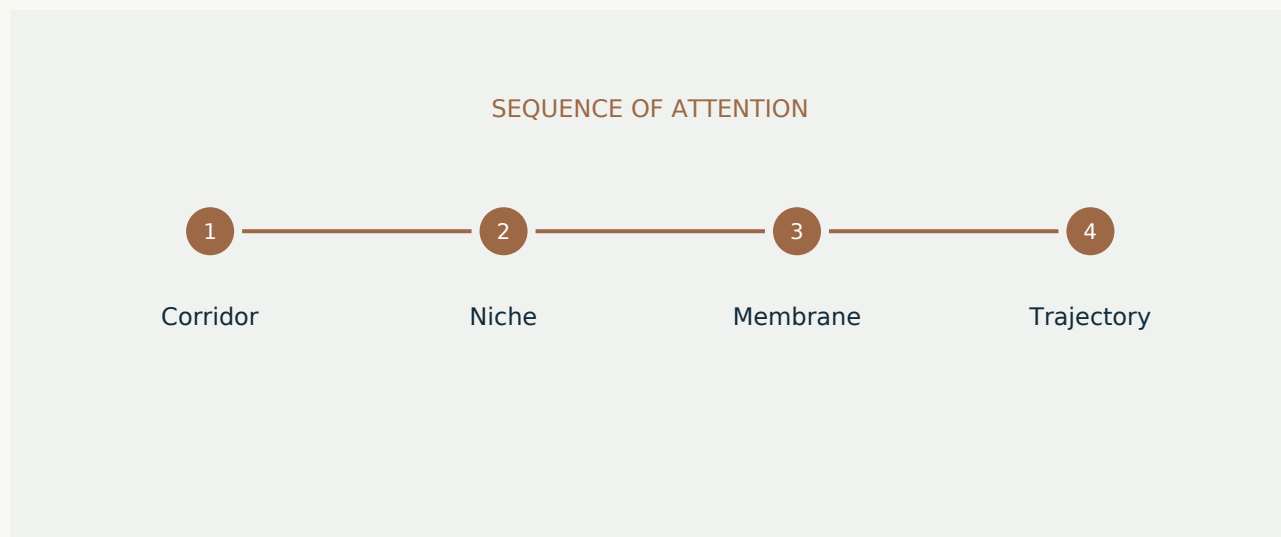


Endoscopic retrotympanic and round-window relationships. This is an anatomical exposure, not an electrode-insertion demonstration; implant-specific steps remain in the text and device guidance.

Source figure 9. Tarabichi M. Endoscopic cholesteatoma, tympanoplasty and middle ear surgery (2013). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 09 / STUDY COMPANION

Separate exposure from insertion



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Niche	A bony recess; seeing it does not prove complete membrane exposure.
--------------	---

Membrane	Identify the intended entry region before the insertion exercise.
-----------------	---

Trajectory	A visible target may still have an unsuitable approach path.
-------------------	--

Discuss at the specimen

An electrode enters smoothly. Has correct intracochlear placement been proved?

No. The external view alone does not establish scala location or exclude trauma. State the actual method used to assess the course and the limits of that assessment.

Record

Record the training device, route, resistance and result-assessment method.

CHAPTER 10

Canal wall down dissection and cavity design

Understand the anatomical change

Canal wall down dissection removes the partition between the external canal and the mastoid cavity to create a common space. It therefore changes both the exposure and the future form of the ear. The exercise should follow documentation of an intact canal-wall mastoidectomy, because the original relationship cannot be recreated simply by replacing a photograph or a label.

In patients, selection between canal-wall strategies depends on disease, anatomy, reconstruction, surveillance and follow-up. The laboratory exercise demonstrates the exposure and cavity geometry; it does not establish which operation an individual patient should receive. Clinical aims include disease control and a manageable ear, with hearing reconstruction considered in the overall plan. [2]

Prepare before removing the wall

Review the position of the facial nerve, lateral canal, tegmen and ossicular chain. Decide whether the chain is to remain intact or whether removal is necessary for the selected exercise. If removal is planned, separate joints and attachments under vision before mobilising the ossicles. Protect the stapes and footplate from transmitted force.

Establish the limits of the wall to be removed. Work from the known mastoid and canal surfaces, keeping the facial-nerve relationship in mind as the bridge between them is reduced. Do not use the removal of the canal wall as a way to resolve an unrecognised facial nerve course.

Develop a continuous cavity

Remove the relevant wall in controlled stages, then inspect the transition between the canal, epitympanum and mastoid. Residual ledges can obstruct inspection and later cleaning. Smooth the cavity according to the intended design without blindly pursuing a flat surface across a neural or labyrinthine boundary.

The facial ridge must be understood anatomically before its contour is altered. Lowering a ridge without knowing the nerve's position converts a geometric exercise into a nerve injury risk. The instructor should demonstrate how the safe contour relates to the individual nerve and the rest of the cavity. No universal ridge height can replace that relationship.

Inspect the inferior cavity and mastoid tip region. An inaccessible dependent recess can remain despite a large superior opening. Consider how the cavity would be viewed and cleaned through the external meatus. This connects the deep bone work with the access required outside it.

Relate the cavity to soft tissue and reconstruction

A bony cavity is not a finished clinical ear. Meatoplasty, lining, graft support, obliteration or canal reconstruction may form part of the clinical operation, depending on its purpose. In a preserved specimen, soft-tissue availability may limit what can be demonstrated. State those limitations rather than presenting bone work alone as a complete reconstruction.

If a reconstruction exercise is planned, preserve or harvest the required material before discarding tissue. Check that the intended lining or graft can reach and cover the relevant surfaces without excessive tension. Separate a demonstration of graft placement from a claim about healing, which cannot be assessed in the laboratory.

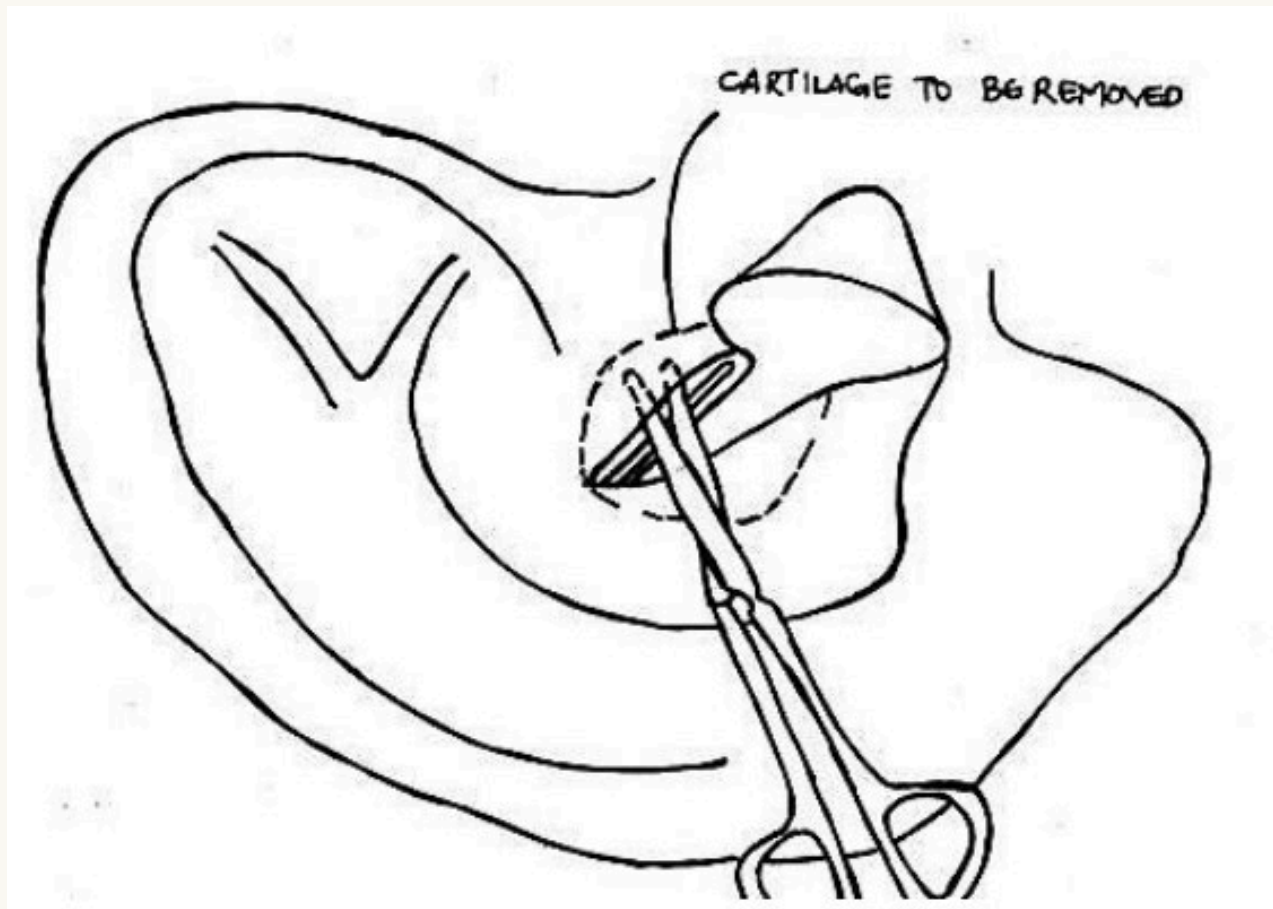
Inspect the final result

Examine the cavity from several angles and identify retained overhangs, hidden recesses and unintended defects. Confirm the status of the facial nerve, labyrinth and stapes region. Document preserved or removed ossicles and any deliberate exposure of dura or sinus covering. Use precise descriptive terms rather than relying only on “modified radical” or another label that may be used differently between centres.

The exercise is complete when the altered cavity can be described as a connected anatomical space and its limitations are understood. The learner should explain how wall removal improved access, which structures now provide orientation and what additional soft-tissue work would be needed in a patient.

CHAPTER 10 / OPERATIVE PLATE 10.11

Meatal enlargement

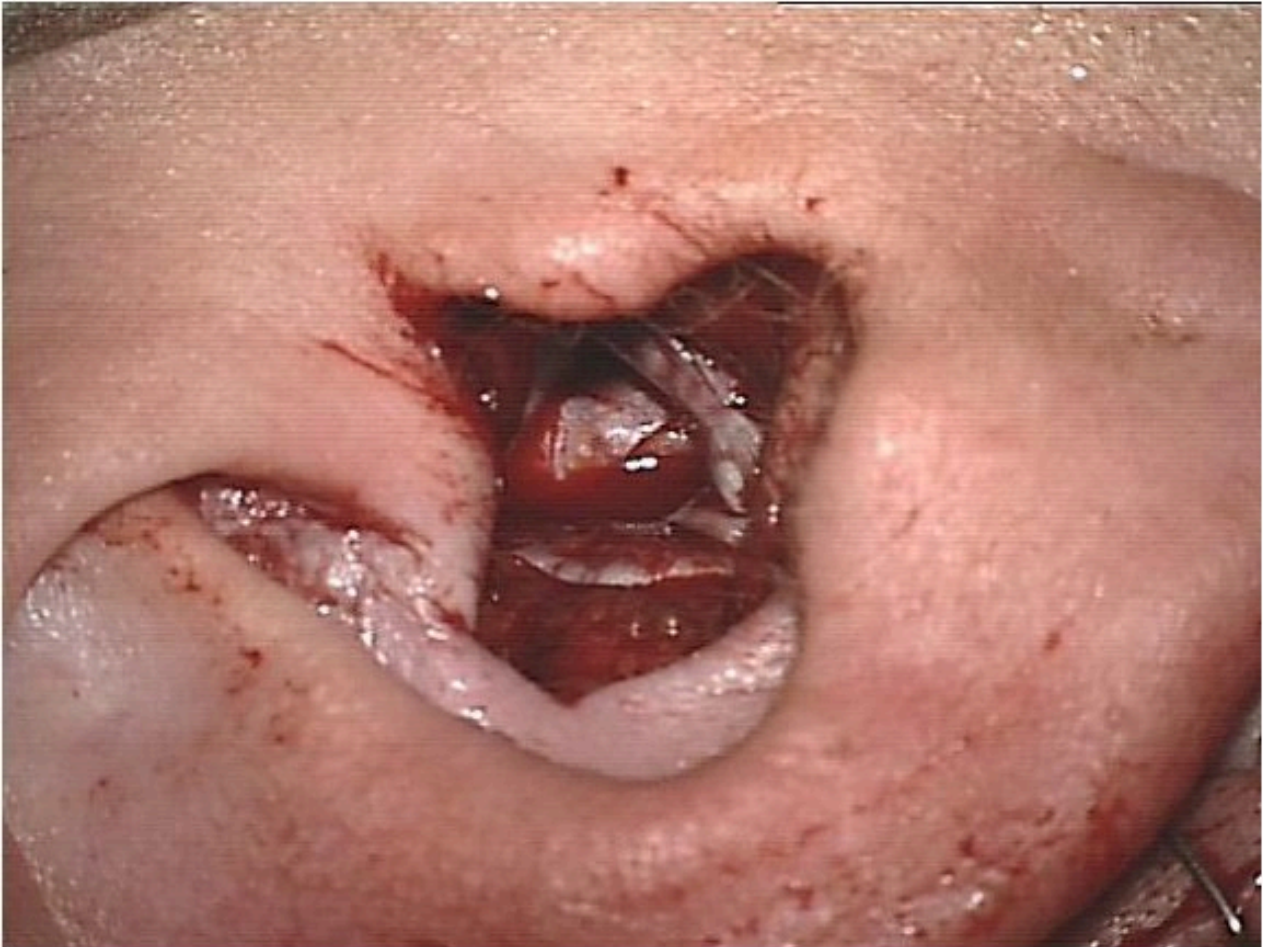


Cartilage work in the source meatoplasty sequence. This plate illustrates the outlet component of cavity surgery, not a complete canal-wall-down dissection.

Source figure 28. Harris T, Linder T. Mastoidectomy and Epitympanectomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 10 / OPERATIVE PLATE 10.12

The completed meatoplasty

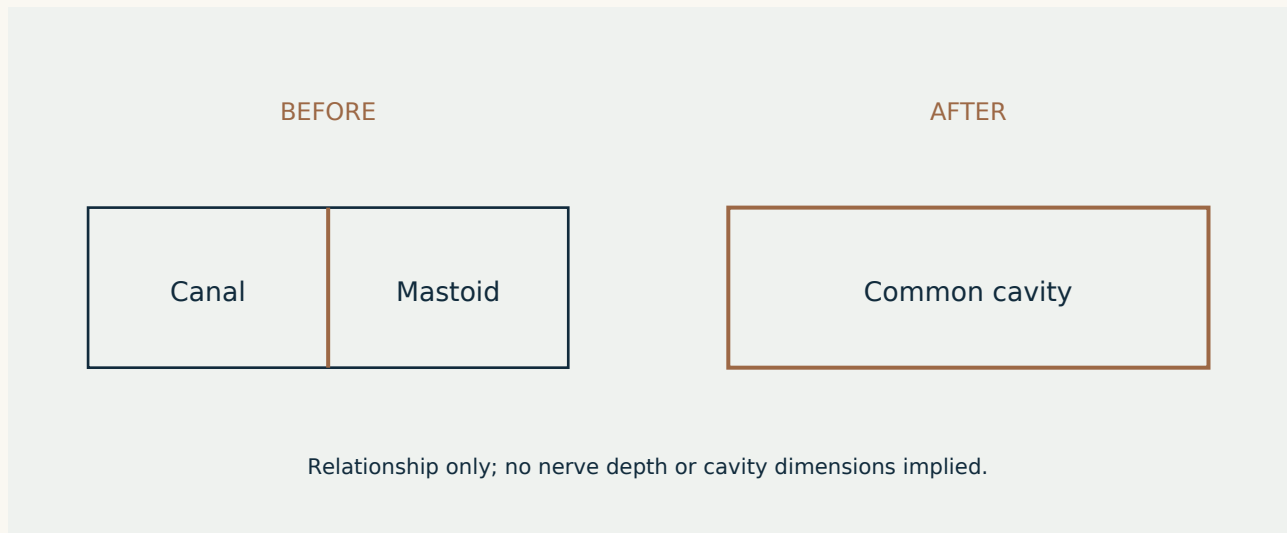


Source appearance after meatoplasty. The access shown should be read with the chapter's cavity-design discussion, without extrapolating dimensions to another ear.

Source figure 29. Harris T, Linder T. Mastoidectomy and Epitympanectomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 10 / STUDY COMPANION

Wall removal changes the architecture



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Before removal	Preserve an intact-wall record and identify the facial-nerve relationship.
After removal	Inspect continuity, ledges, dependent recesses and access through the meatus.
Beyond bone	Lining, reconstruction and follow-up remain separate clinical considerations.

Discuss at the specimen

Why is a large superior opening not enough to describe a satisfactory cavity?

It may leave poorly accessible inferior or dependent recesses. Review the whole connected space and how it would be inspected through the external access.

Record

Identify one area where access, rather than volume, determines the result.

CHAPTER 11

The ossicular chain and reconstruction principles

Study the intact chain first

The malleus, incus and stapes form a connected mechanical system. Their joints, ligaments and tendons must be understood before individual bones are removed. Examine the manubrium and malleus head, incus body and processes, incudostapedial joint, stapes superstructure and footplate region through the available approaches. Preserve the intact configuration in photographs before altering it.

Use controlled movement to assess continuity under supervision. A preserved specimen may have stiffness unrelated to disease, and a harvested chain may already be disrupted. Record these limitations. Do not interpret apparent mobility as proof of normal hearing mechanics or an immobile fixed specimen as otosclerosis.

Prepare for removal or reconstruction

When an exercise requires ossicular removal, plan the sequence so that force is not transmitted unpredictably to the footplate. Separate the relevant joint under direct vision and release attachments deliberately. Keep removed ossicles in a labelled container. Their condition determines whether they remain suitable for a reconstruction demonstration.

After removal, inspect the remaining platform for reconstruction. Identify whether the stapes superstructure is present and whether the footplate region is intact. Assess the relationship of the malleus handle, tympanic membrane or intended graft to the residual chain. The reconstruction must fit the actual anatomy rather than a memorised prosthesis shape.

Understand coupling and stability

A partial ossicular replacement reconstruction and a total reconstruction address different residual configurations. The distinction depends on what remains to support and transmit sound. Choice of material, prosthesis and stabilisation varies with the ear and technique; the laboratory should use the selected system's instructions rather than a generic length or angle.

Measure or size the reconstruction within the exposed field as instructed. A prosthesis that is too long can impose excessive tension, while inadequate support or a poor orientation can permit displacement. The important exercise is to understand the line of transmission and the points of contact. Do not judge success only by whether the component can be balanced in position momentarily.

Support the reconstruction while replacing the membrane or graft. Reinspect its position when possible after the overlying tissue is returned. A stable appearance before flap replacement may change when the tissue is laid back. Packing or support material should serve the selected technique and should not conceal an uncertain contact.

Preserve the footplate region

Avoid direct force, traction or levering on the footplate. When the superstructure is absent, the remaining interface may be particularly vulnerable. If its stability is uncertain, stop the reconstruction exercise and inspect it with the instructor. Continuing to fit a prosthesis onto a damaged platform can disguise the original injury.

Distinguish removal of obstruction from manipulation of a mobile structure. A fragment near the oval window may not be loose debris. Identify its attachment before retrieving it. The fact that an instrument can reach the region does not establish that contact is harmless.

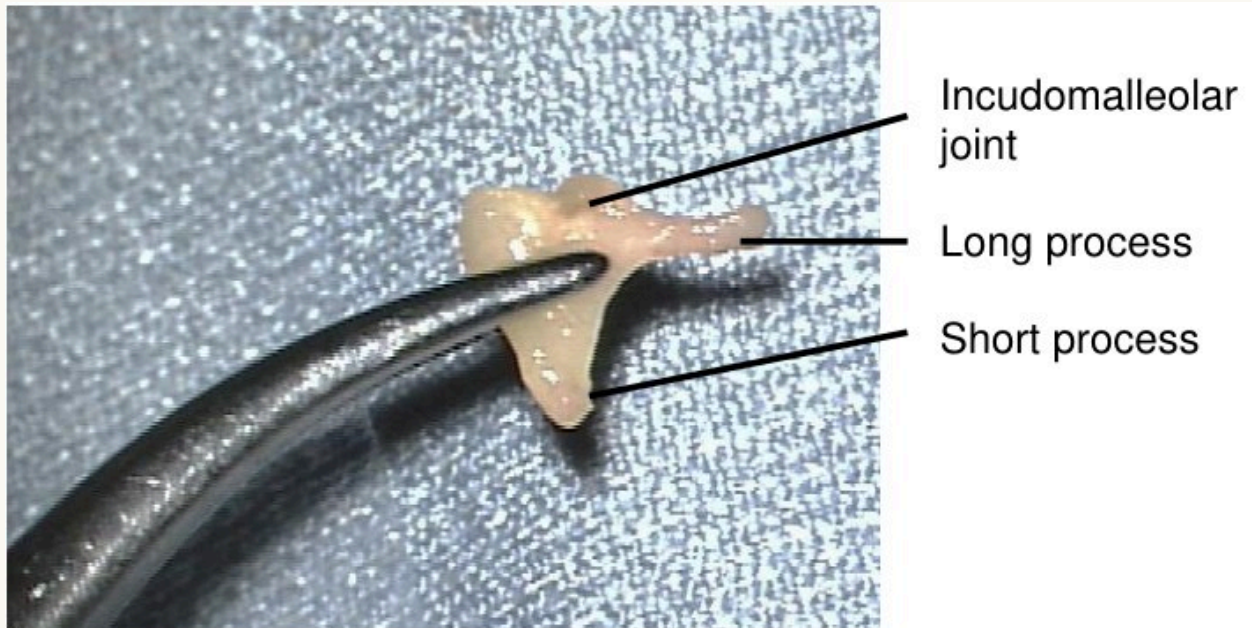
Evaluate the exercise honestly

Document the residual anatomy, reconstruction material, support and final position. Record whether the result was inspected from one or several views and whether the membrane or flap was replaced. Laboratory reconstruction demonstrates handling, sizing and placement. It cannot establish postoperative hearing, middle-ear aeration, long-term stability or extrusion risk.

Common errors include failing to document the original chain, transmitting force to the stapes during removal, using an unsuitable length and changing the reconstruction during flap replacement. Review the movement that produced each problem. A useful reconstruction session ends with an explanation of both the intended mechanical arrangement and the limits of what the specimen can demonstrate.

CHAPTER 11 / OPERATIVE PLATE 11.11

Preparing an incus graft

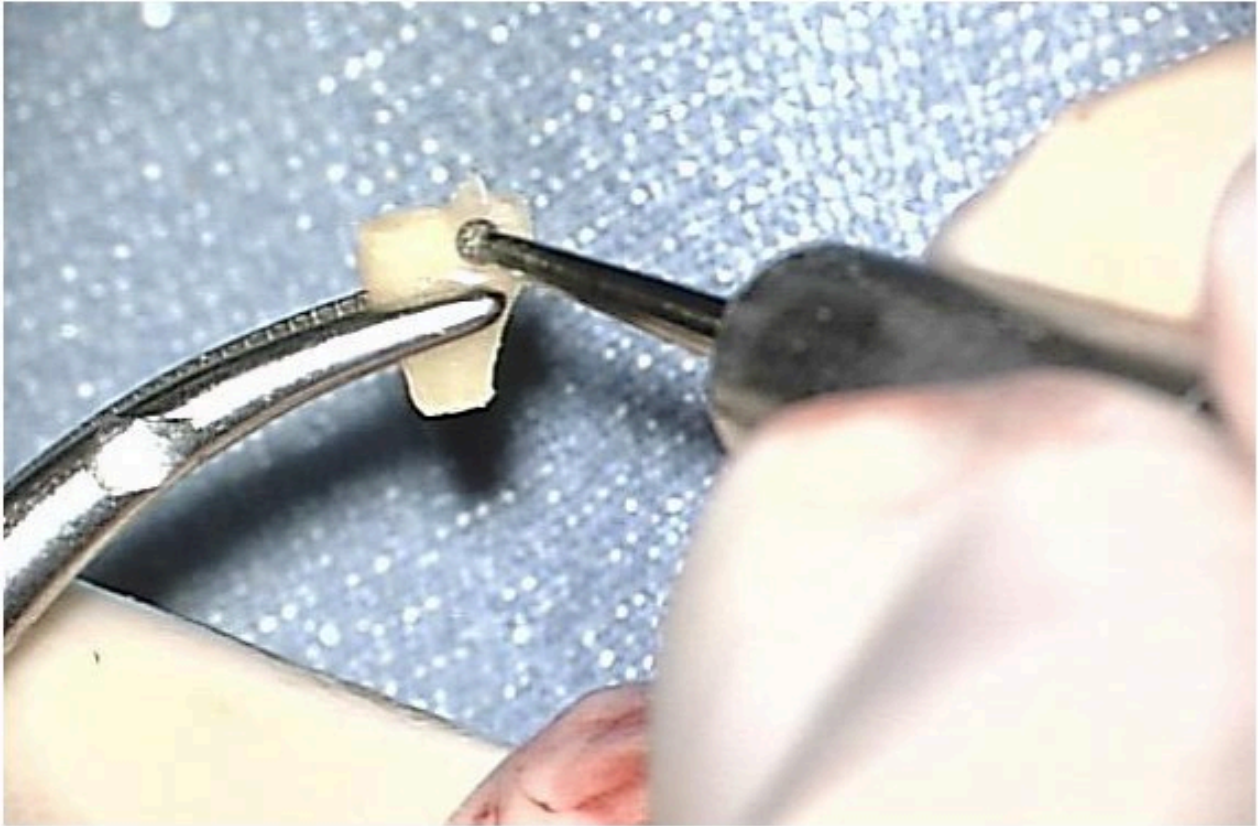


Source incus preparation with its retained annotations. Graft geometry is specific to the ossicular defect and the surviving support points.

Source figure 3. Harris T, Linder T. Ossiculoplasty (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 11 / OPERATIVE PLATE 11.12

Articulation surface

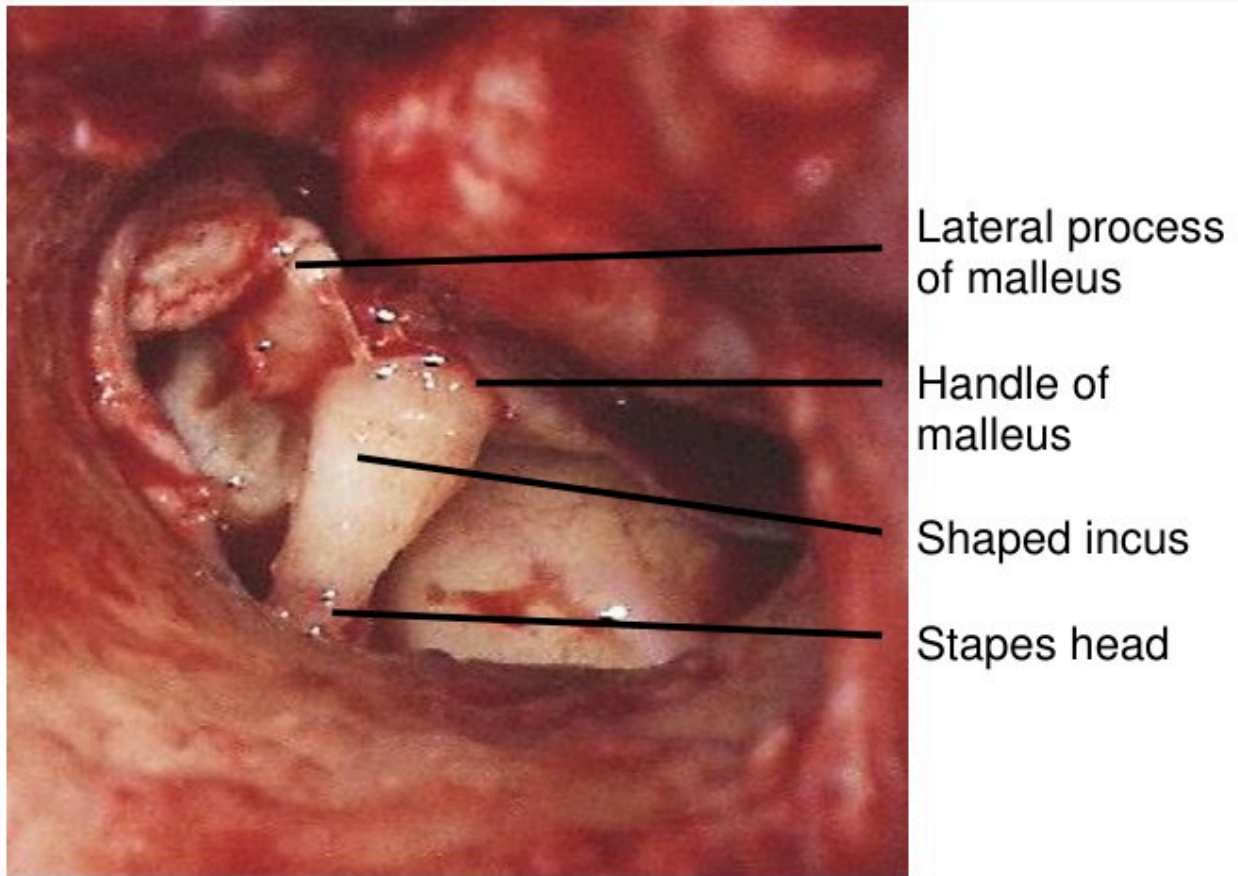


Shaping the incus graft for its intended articulation in the source technique. The image illustrates a preparation stage, not a sizing prescription.

Source figure 5. Harris T, Linder T. Ossiculoplasty (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 11 / OPERATIVE PLATE 11.13

Incus interposition

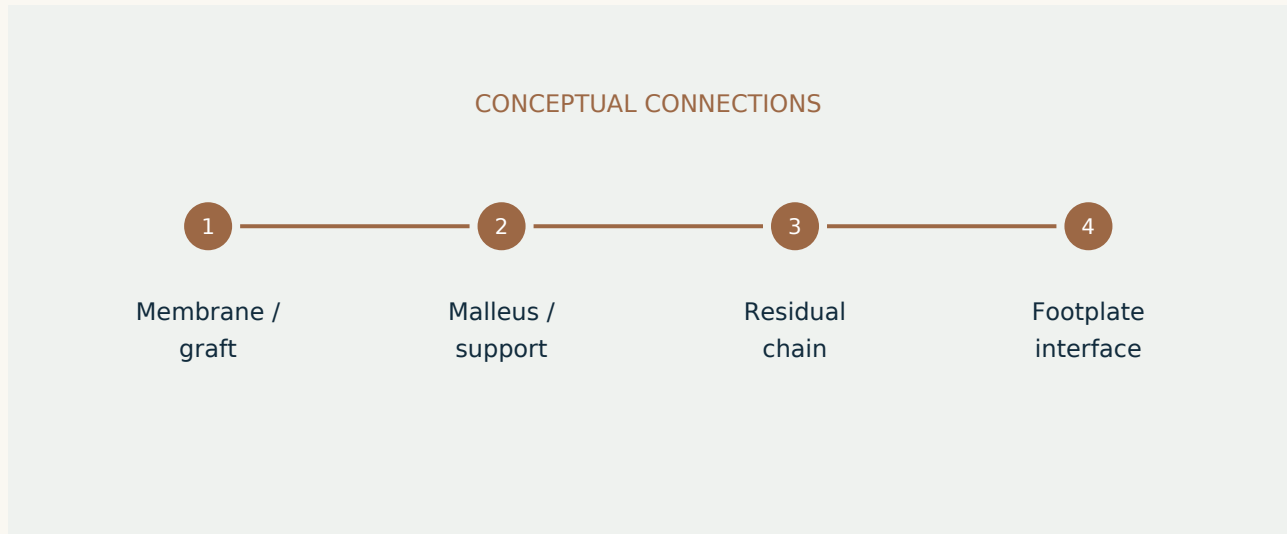


Labelled source reconstruction. Assess contact and stability in the actual middle ear; photographic alignment does not establish functional coupling.

Source figure 7. Harris T, Linder T. Ossiculoplasty (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 11 / STUDY COMPANION

Reconstruct from what remains



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Baseline	Record the intact or deficient chain before removal or fitting.
Contact	Account for every load-bearing interface and avoid excess tension.
Recheck	Assess the position again after replacing the membrane or flap.

Discuss at the specimen

The reconstruction looks stable before flap replacement. Is the exercise finished?

No. Replacement can change alignment and support. Reassess the final configuration and document the views used, without claiming a hearing outcome.

Record

Describe the residual anatomy and the reason for the selected reconstruction.

CHAPTER 12

The stapes and oval window

Establish the anatomy before the procedure

The stapes exercise begins with adequate exposure of the incudostapedial joint, tendon, crura and footplate region. The chorda tympani and tympanic facial-nerve relationship must be understood throughout. If a canal-wall overhang limits the view, improve exposure cautiously under supervision rather than working around it with an unseen instrument tip.

A fixed stapes footplate is a clinical finding established in context. The condition of a fixed or desiccated specimen cannot establish otosclerosis. In patients, stapes surgery requires audiological assessment, appropriate diagnosis, counselling and evaluation of anatomical or inner-ear factors that may change its suitability. This chapter is a supervised anatomical and technical exercise, not a patient-selection protocol. [5]

Prepare the sequence

There are legitimate variations in the order of stapes surgery, including when the fenestra is created relative to removal of the superstructure. The instructor should choose and demonstrate one coherent technique for the exercise. Do not combine isolated steps from different methods without accounting for the support and protection each sequence provides.

Before changing the chain, identify the footplate position and the space available beneath the facial nerve. Plan the prosthesis system and measurement method. A universal piston length or fixed instrument excursion is inappropriate. Device dimensions and attachment mechanisms differ and must be matched to the anatomy and the manufacturer's instructions.

Separate and remove structures under vision

If the selected exercise requires separation of the incudostapedial joint, control the direction of force and avoid displacing the stapes inward. Divide the tendon and manage the crura according to the demonstrated technique. Preserve the long process of the incus and avoid using it as a lever. Remove the superstructure without transmitting an uncontrolled movement to the footplate.

Inspect the footplate after each step. An apparently intact plate may have changed position or acquired a fracture. If it becomes mobile unexpectedly, stop and seek instructor review. Do not continue fenestration merely because it was the next planned step.

Fenestration and prosthesis handling

A stapedotomy creates a small opening in the footplate; a stapedectomy removes a larger portion or the whole footplate according to the technique. These should be taught as distinct exercises. The selected drill, laser or manual method requires equipment-specific instruction. Laser settings and prosthesis preparation cannot be generalised from one system to another.

Create and inspect the intended opening with controlled depth and continuous visual attention. Avoid blind suction or probing within the vestibule. Introduce the selected training prosthesis according to its instructions, assess its position and secure the attachment using the appropriate method. Attachment should couple the prosthesis without damaging the incus or displacing the footplate interface.

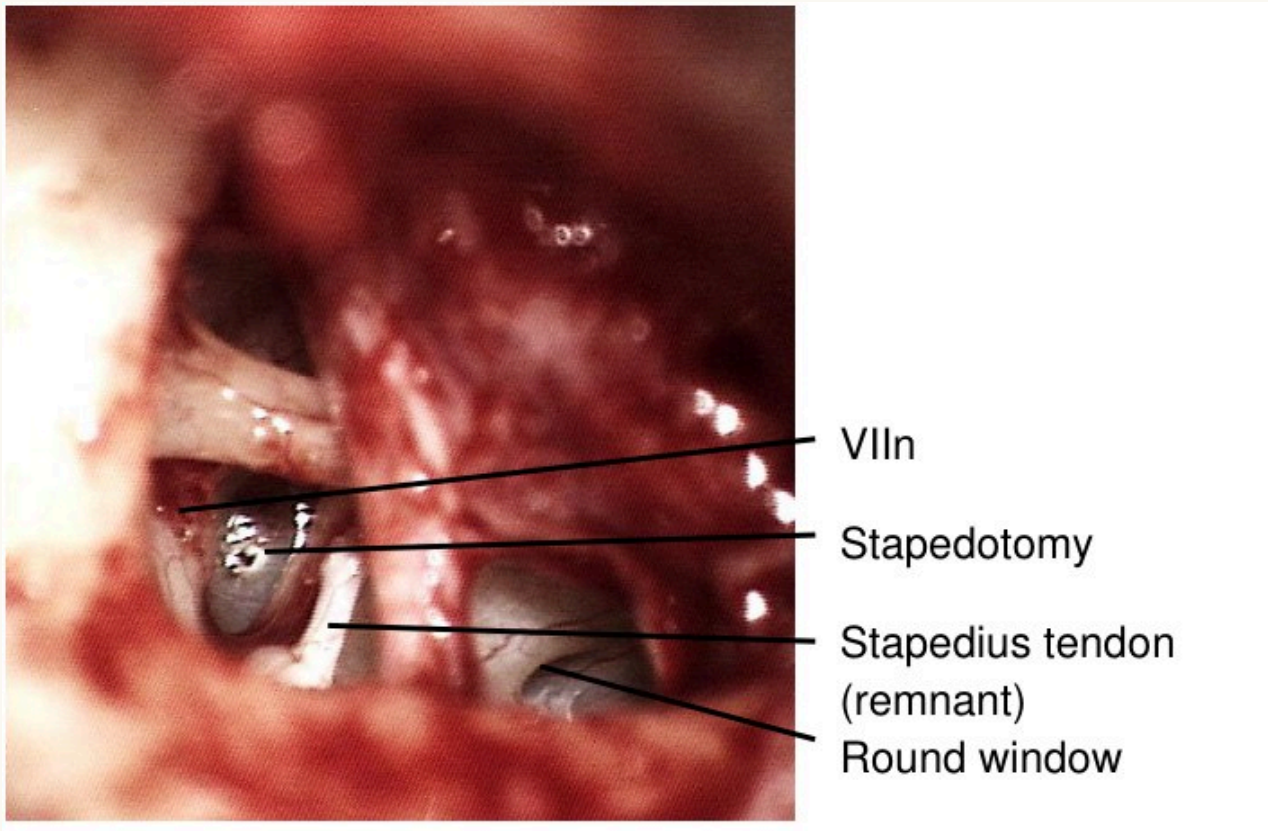
Restricted exposure and unexpected findings

A prominent or anomalously positioned facial nerve can limit access to the oval window. An uncertain vascular or inner-ear anomaly changes the clinical problem. These are reasons for specialist reassessment, not invitations to force the standard sequence into an unsuitable field. In the laboratory, retain the abnormal relationship for study where possible.

At completion, inspect the chorda, incus, footplate region and prosthesis position. Replace the flap and note whether placement remains stable. Record any mobilisation of the plate, fracture or unplanned inner-ear entry. The quality of the exercise depends on recognising these events as well as completing the intended reconstruction.

CHAPTER 12 / OPERATIVE PLATE 12.11

Footplate fenestration

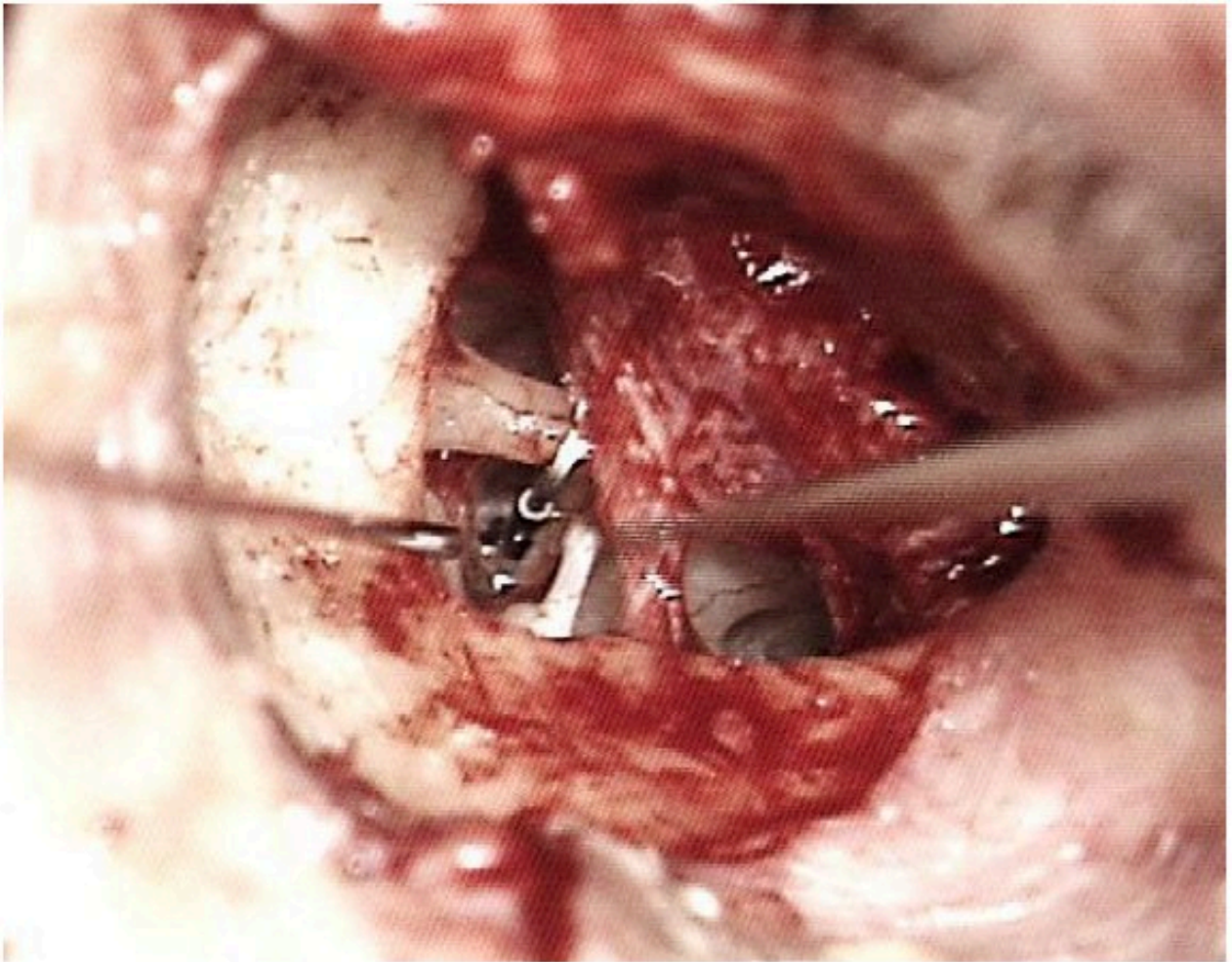


Source stapedotomy view with original labels. The atlas describes a particular operative sequence; this image does not make that sequence universal.

Source figure 12. Harris T, Linder T. Incus and malleostapedotomy, stapedectomy, stapedotomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 12 / OPERATIVE PLATE 12.12

Prosthesis placement

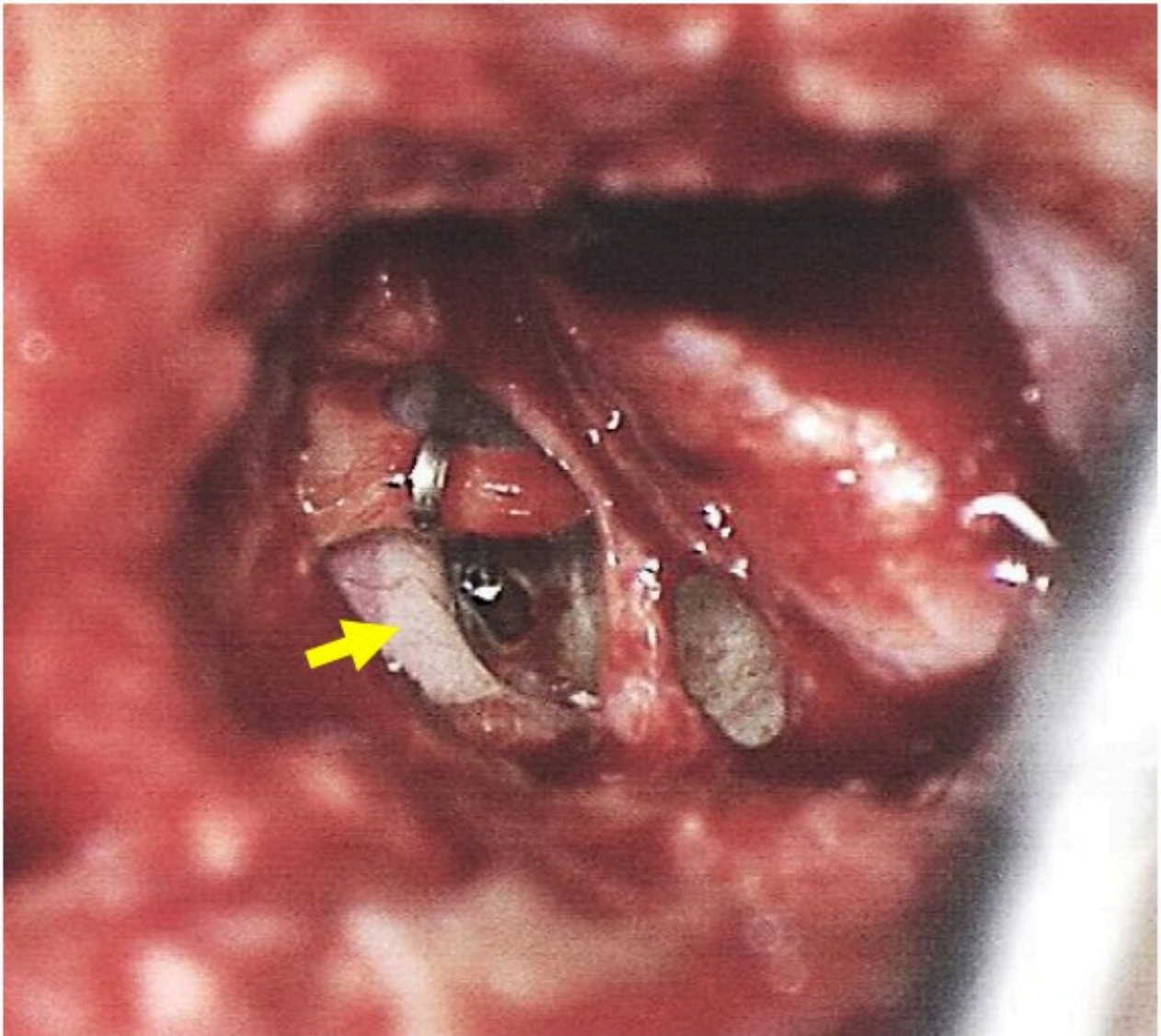


Source stage of prosthesis placement. Device selection and attachment require the relevant instructions and supervised technique.

Source figure 17. Harris T, Linder T. Incus and malleostapedotomy, stapedectomy, stapedotomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 12 / OPERATIVE PLATE 12.13

Final prosthesis relationship

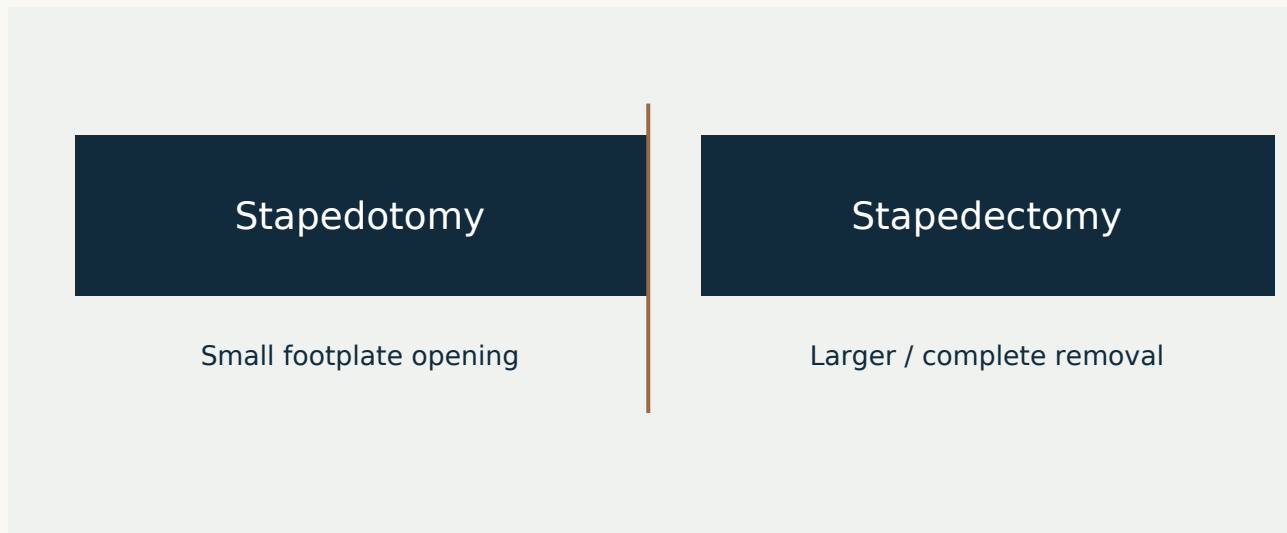


Final source relationship of the prosthesis to the incus and footplate. The image is not a substitute for direct assessment of position and mobility.

Source figure 18. Harris T, Linder T. Incus and malleostapedotomy, stapedectomy, stapedotomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 12 / STUDY COMPANION

Distinguish the opening from the operation



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Sequence	Use one instructor-selected technique rather than mixing isolated steps.
Interface	Reassess the footplate whenever the mechanical state changes.
Device	Sizing and attachment follow the chosen system and observed anatomy.

Discuss at the specimen

The footplate becomes unexpectedly mobile before the planned fenestration. What changes?

The assumed support has changed. Stop the planned sequence for instructor reassessment; proceeding merely because fenestration comes next ignores a new finding.

Record

Record any unplanned plate movement separately from the intended opening.

CHAPTER 13

The intratemporal facial nerve

Study the nerve as a continuous structure

The facial nerve should be understood along its intratemporal course rather than as an isolated landmark in the mastoid. From the internal auditory canal it enters the labyrinthine segment and reaches the geniculate region, then continues through the tympanic segment and second genu into the mastoid segment before leaving at the stylomastoid foramen. The greater petrosal nerve, nerve to stapedius and chorda tympani provide additional relationships along this course.

The route used to expose one segment may endanger another. Mastoid work approaches the descending segment and second genu, while middle-ear work places the tympanic segment near the oval window in the field. Superior approaches bring the geniculate and labyrinthine regions into consideration. Reorient the specimen before changing between these views.

Identify before skeletonising

Begin with established surrounding anatomy. Inspect the relationship of the lateral canal, incus region, posterior canal wall and inferior mastoid before estimating the descending nerve course. The estimate guides attention; it is not a substitute for identifying the bony canal. Trace a recognised segment progressively rather than drilling at a point selected from a diagram alone.

Skeletonisation means defining the bony covering sufficiently to understand the course. It does not necessarily mean opening the canal or exposing the nerve itself. Keep these objectives separate before beginning. A basic mastoid or facial recess exercise may require awareness and preservation of the nerve without formal decompression.

Use controlled bone work, appropriate irrigation and a view that shows the contact surface. Do not rely on a pale-yellow appearance as a universal signal. Fixation, bone thickness and natural variation alter what is visible. The shaft, suction and instruments adjacent to the burr also require attention near the nerve.

Follow the relationships through the turns

At the second genu, relate the change in direction to the surrounding labyrinthine and middle-ear anatomy. In the tympanic segment, inspect its relationship to the oval-window region. A dehiscent or unusually positioned segment may be vulnerable without any protective plate being removed by the learner. Treat an uncertain soft-tissue structure in this location as significant until its identity is established.

The geniculate and labyrinthine regions require a different exposure and should not be pursued by extending a limited mastoid view blindly. If the specimen and course include a

superior approach, inspect these structures from that route under specialist guidance. Document which segments were actually seen and which remained inferred.

Distinguish exposure from decompression

Facial-nerve decompression in a patient requires an indication, timing decision, functional assessment and an appropriate surgical route. Laboratory removal of a bony covering does not reproduce those decisions. Opening the canal or nerve sheath is a separate and potentially destructive step, not the automatic completion of skeletonisation.

Where a dedicated exercise includes canal opening, the instructor should define its limits and demonstrate protection of the underlying tissue. Preserve the nerve for inspection rather than pulling it out to make its course easier to see. If a segment is intentionally removed for internal study, record the stage before and after removal so that the original relationship remains documented.

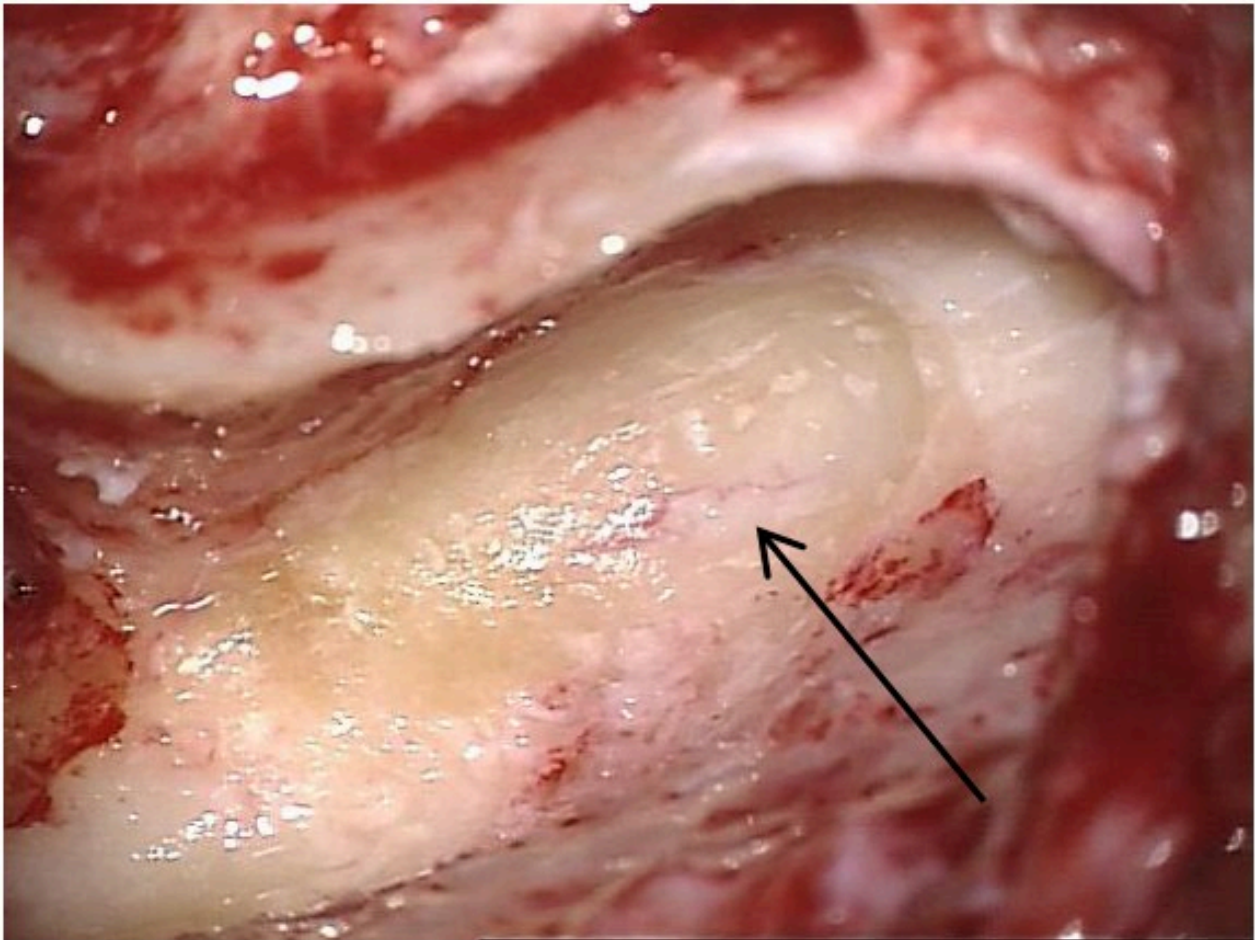
Review injury and preservation

Inspect for bony discontinuity, direct instrument contact, traction and tissue disruption. A visually continuous nerve is not proof of preserved function; thermal or pressure injury may not be apparent in a cadaver. Likewise, monitoring in a patient complements rather than replaces anatomical technique.

A suspected injury should stop the relevant manoeuvre. Preserve the field and obtain instructor review. Record the instrument, site and likely mechanism without continuing simply to complete the exposure. The useful lesson is the relationship between the movement and the injury, not the ability to conceal the defect in a more extensive dissection.

CHAPTER 13 / OPERATIVE PLATE 13.11

Distal facial-nerve reference

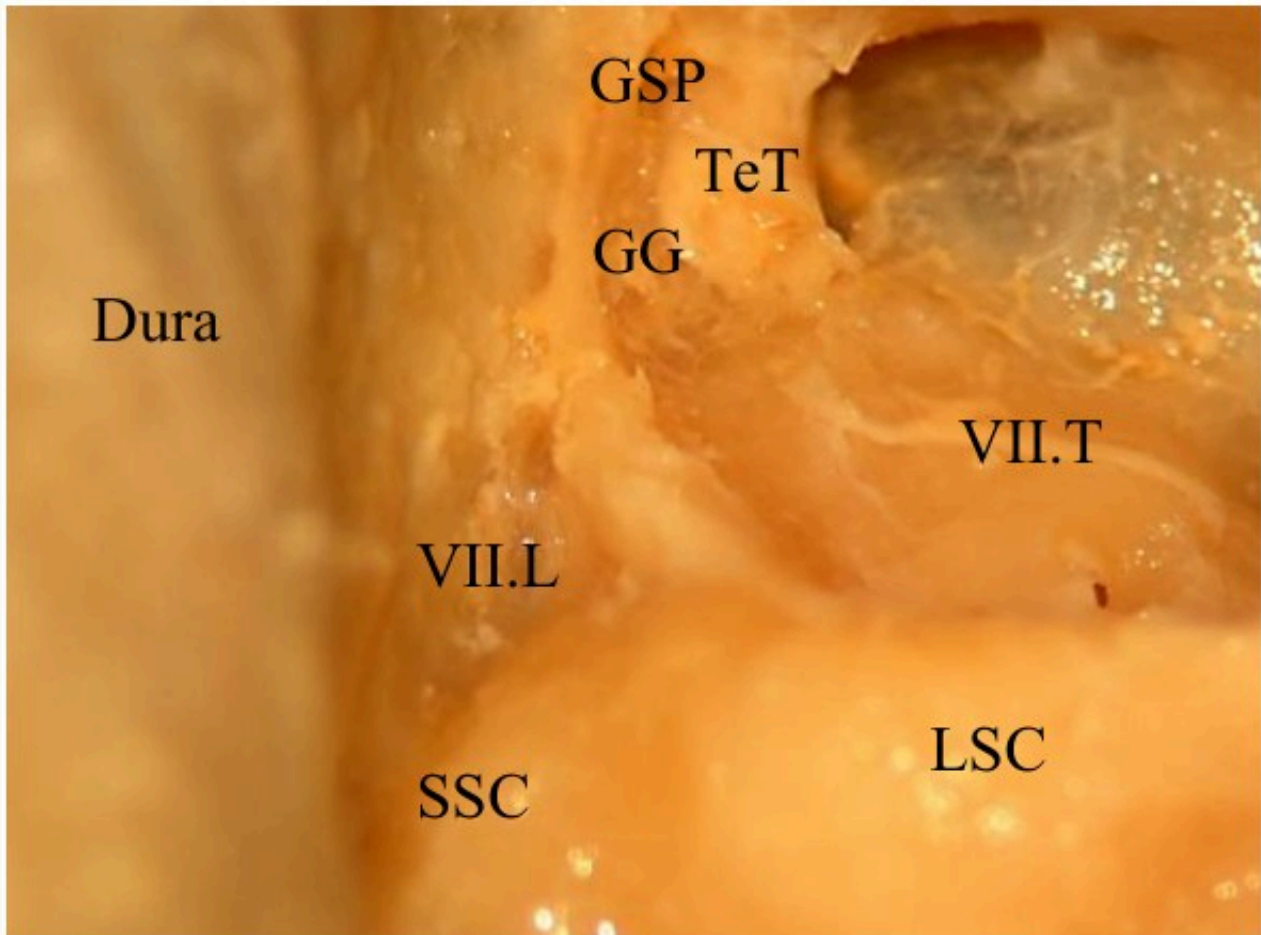


Source view of the distal facial-nerve region in relation to the digastric landmark. Labels are retained; colour alone does not identify the nerve.

Source figure 19. Harris T, Linder T. Mastoidectomy and Epitympanectomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 13 / OPERATIVE PLATE 13.12

Proximal relationships

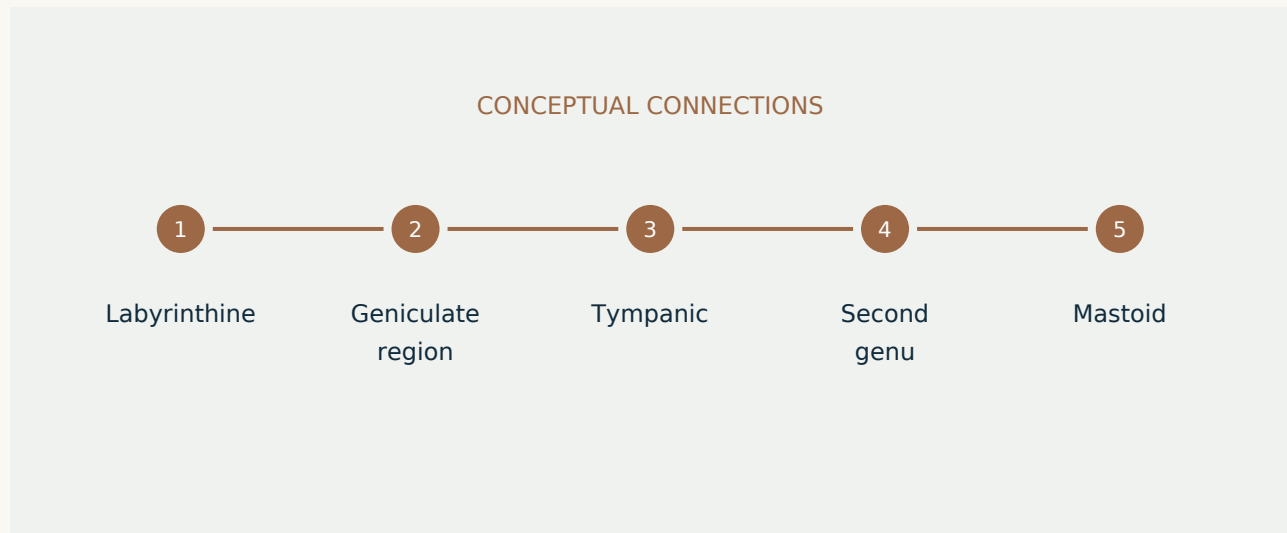


Attic and proximal facial-nerve relationships in the source exposure. Read the retained labels against the actual extent of bone removal.

Source figure 23. Harris T, Linder T. Mastoidectomy and Epitympanectomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 13 / STUDY COMPANION

Follow continuity, not a yellow spot



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Course	Relate successive segments and bends to the surrounding bone.
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Covering	Distinguish skeletonisation from opening the bony canal or nerve sheath.
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Interpretation	Colour and visible continuity alone do not establish nerve integrity.
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Discuss at the specimen

Is a nerve that appears continuous necessarily functioning normally?

No. A laboratory specimen cannot demonstrate live function, and visual continuity cannot exclude injury. Record exactly what was inspected and preserved.

Record

State whether bone, sheath or the nerve itself was actually exposed.

CHAPTER 14

The labyrinth and endolymphatic sac region

Preserve the external relationships first

The bony labyrinth contains the cochlea, vestibule and semicircular canals. Before opening any component, identify the exposed otic-capsule surface and relate it to the mastoid, facial nerve and middle-ear windows. The lateral canal prominence provides an important reference during mastoid work, but the complete arrangement of the canals requires deliberate three-dimensional study.

Trace the anticipated superior and posterior canal relationships using the available views and imaging. Recognise the relationship of the superior and posterior canals to their common crus. Their orientation is easier to understand when the specimen is rotated and the full arcs are considered rather than when one small surface prominence is labelled in isolation.

Distinguish skeletonisation from opening

A labyrinth-preserving exercise removes surrounding bone while retaining the integrity of the otic capsule. A labyrinthectomy intentionally opens or removes labyrinthine structures and is destructive to inner-ear function. These exercises should be planned and recorded separately. Photograph the intact external relationships before proceeding to destructive work.

When skeletonising, keep the surface continuously visible and use controlled technique with irrigation. Avoid allowing a burr to dwell on one point simply to produce a dramatic blue line or translucent shell. The desired visual effect is not a reason to compromise the structure. If an unintended opening occurs, stop and assess it with the instructor.

Study the posterior labyrinthine region

Relate the posterior canal, posterior fossa plate, sigmoid sinus and inferior labyrinthine region. The amount of available space varies. A narrow corridor may be an anatomical limitation, not incomplete drilling. Define the structures that constrain the field before considering whether it can be extended.

The endolymphatic sac region is approached in relation to the posterior labyrinth and posterior fossa dura. An extended line based on the lateral canal can be an orientation aid, but it is not a universal guarantee of the sac's position. Preserve the relationship of the vestibular aqueduct and dura when the specimen allows it. Do not label any thickened dural patch as the sac without corroborating anatomy.

Undertake destructive labyrinthine study deliberately

For a supervised labyrinthectomy exercise, establish the external canal anatomy before opening it. Work through the selected structures in the instructor's sequence and follow their lumina rather than creating a broad undirected defect. Relate the ampullary regions and vestibule to the previously recognised surfaces. Protect the facial nerve and distinguish the vestibule from the internal auditory canal.

The membrane and fluid behaviour of the living labyrinth cannot be reproduced reliably in preserved material. Do not infer clinical tolerance from the ease with which a cadaveric structure can be opened. Clinical labyrinthectomy has a functional purpose and consequences that require specialist selection and counselling; the laboratory demonstration is anatomical.

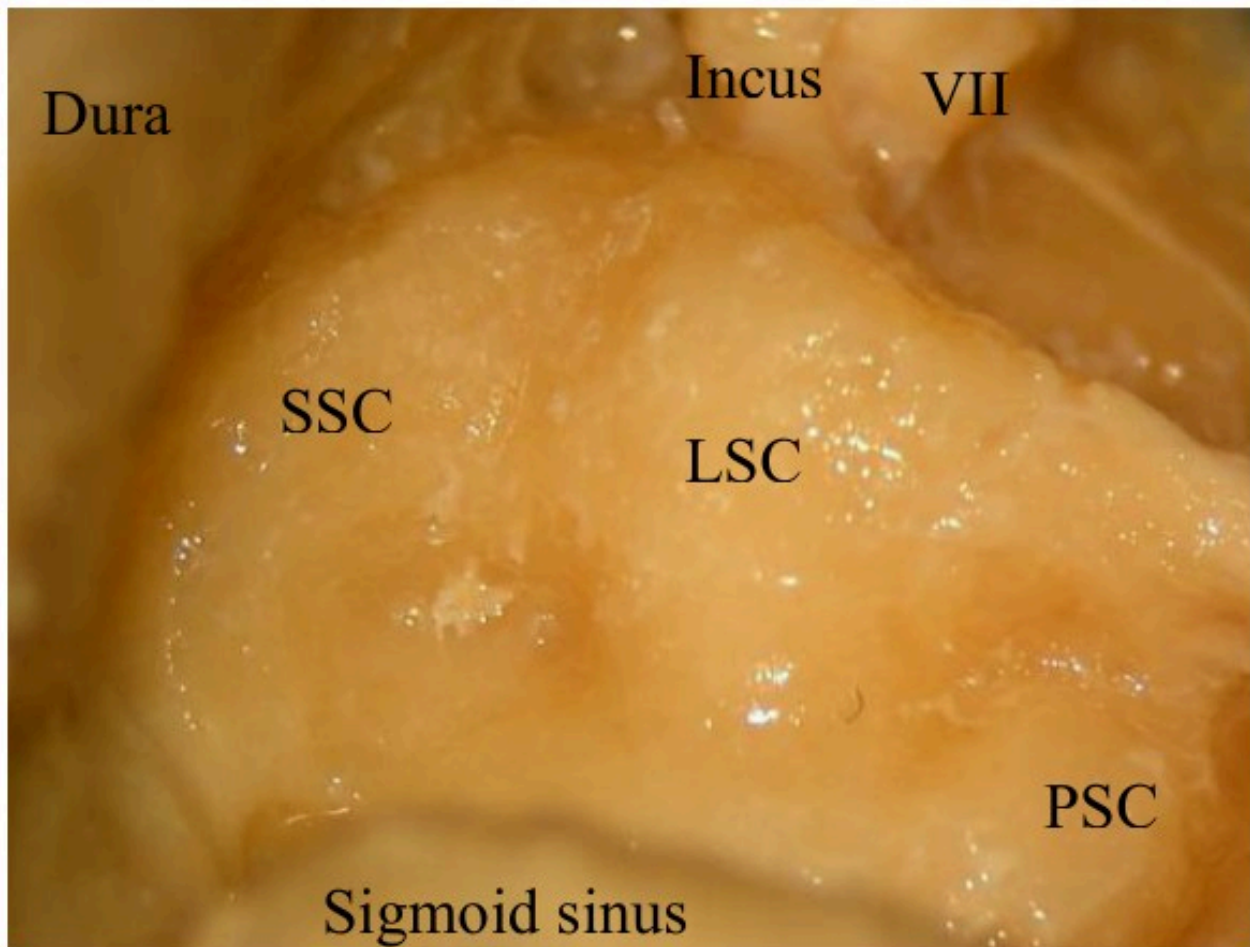
Complete the three dimensional account

Compare the specimen before skeletonisation, after skeletonisation and after intentional opening. Identify where the exercise changed from preservation to destruction. Show how the canal arcs, vestibule and adjacent facial nerve relate to one another. Record any unintended violation that occurred before the planned opening.

Common errors include mistaking an incomplete canal outline for its full course, pursuing translucency excessively and assuming that a larger posterior field is always obtainable. Completion means a correct account of the labyrinth's relationships and the extent of the work, not maximum removal of surrounding bone.

CHAPTER 14 / OPERATIVE PLATE 14.11

Labyrinth and adjacent structures

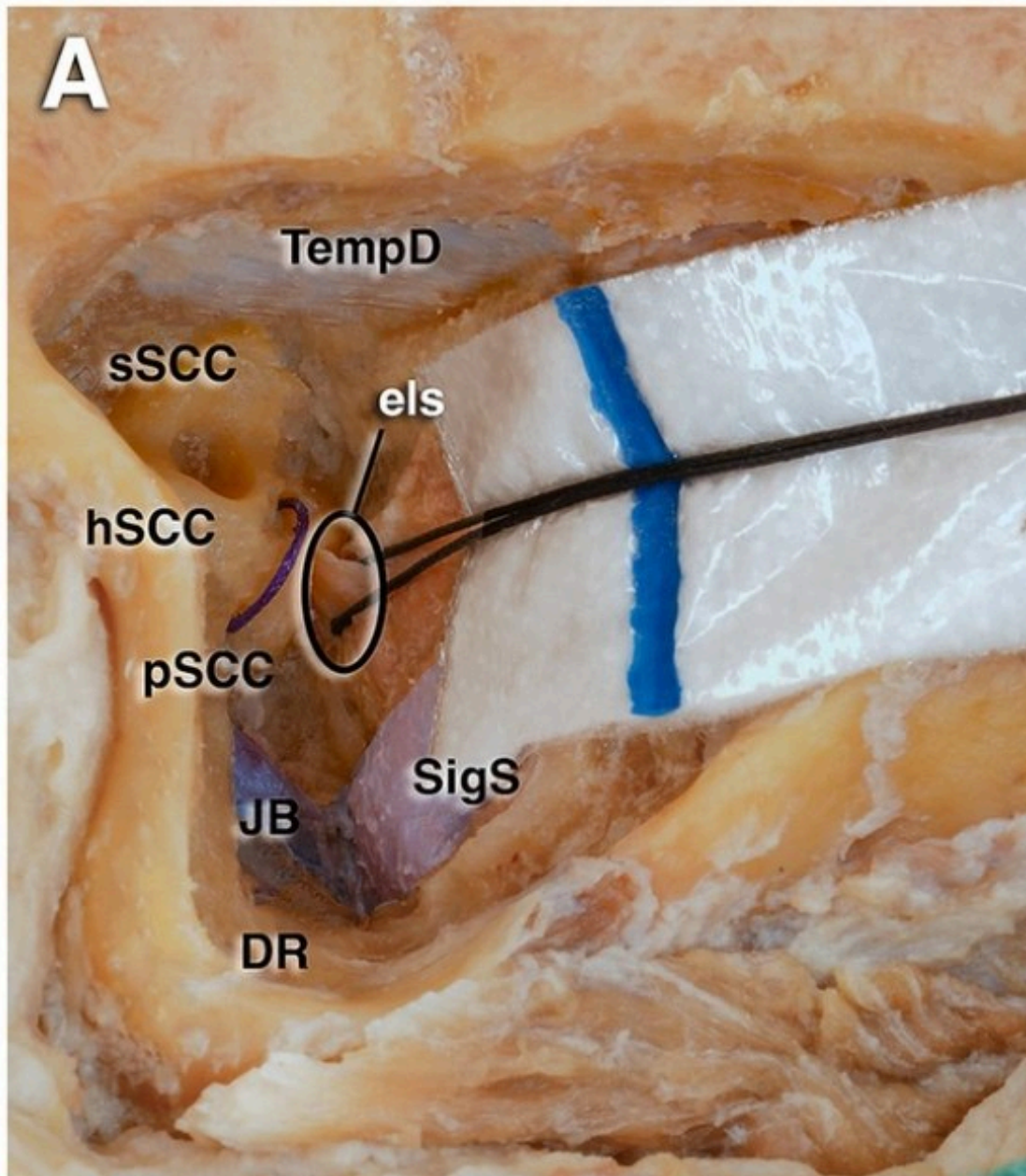


Source labelled labyrinthine relationships. This view is a reference for orientation and does not imply that unroofing is required in routine mastoid surgery.

Source figure 18. Harris T, Linder T. Mastoidectomy and Epitympanectomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 14 / OPERATIVE PLATE 14.12

Endolymphatic-sac relationships

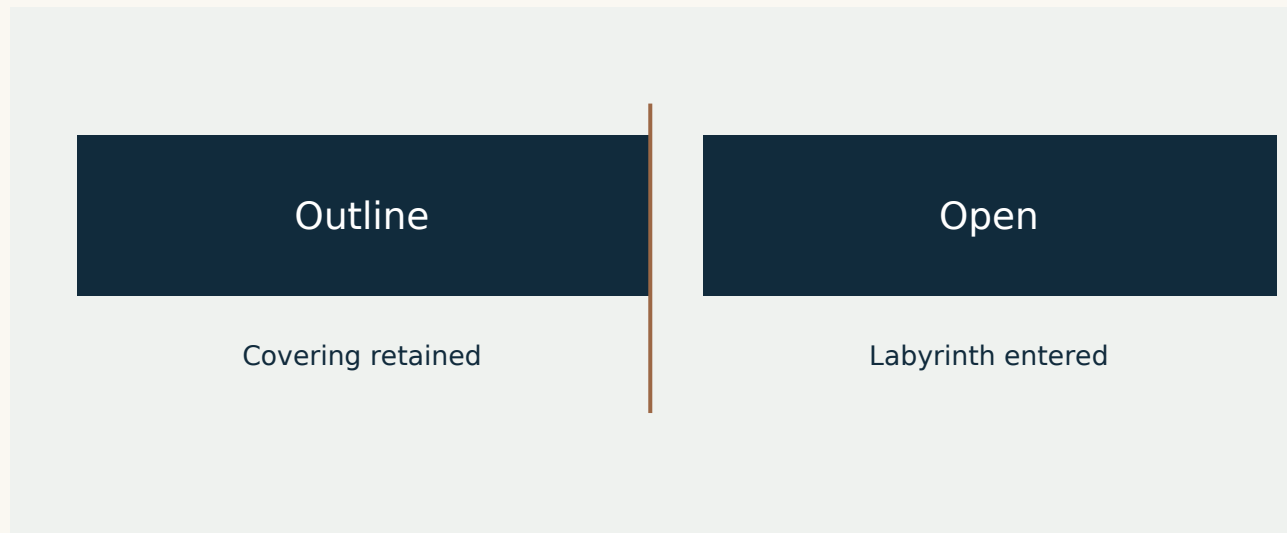


Panel A: endolymphatic sac (els), superior/horizontal/posterior semicircular canals (sSCC/hSCC/pSCC), sigmoid sinus (SigS), jugular bulb (JB), temporal dura (TempD) and digastric ridge (DR). Panel extracted from the original multipanel figure.

Source figure 7A. Sevgi UT et al. Anterolateral, lateral, and posterior corridors to complex skull base lesions (2026). Front Neurol 17:1736101. CC BY 4.0.

CHAPTER 14 / STUDY COMPANION

Name the point of irreversible change



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

External study Relate the canal arcs and vestibule before opening the labyrinth.

Destructive study Agree and document the stage at which preservation ends.

Sac region Use corroborating anatomy; a reference line does not fix every specimen's sac position.

Discuss at the specimen

Can an easily opened preserved labyrinth demonstrate clinical tolerance of that manoeuvre?

No. Preserved anatomy cannot reproduce living vestibular or hearing consequences. The laboratory endpoint is anatomical, not a functional result.

Record

Mark the last preserved stage and the first deliberately destructive stage.

CHAPTER 15

The internal auditory canal and translabyrinthine exposure

Define the advanced exercise

The translabyrinthine route reaches the internal auditory canal through a deliberately opened labyrinth. It is a hearing-sacrificing route in clinical use and should be distinguished from approaches designed to retain labyrinthine function. Advanced temporal-bone exercises require a suitably preserved specimen and specialist supervision. An incomplete isolated bone may not permit the intracranial relationships or closure to be demonstrated.

Before beginning, review the mastoid, facial nerve, labyrinth, jugular region and posterior fossa relationships. Complete and document the hearing-preserving exercises first. The learner should understand what will be lost when the labyrinth is removed and how that loss changes subsequent orientation.

Develop the anatomical route

An adequate mastoid exposure precedes the labyrinthine stage. Establish the relevant dural and venous boundaries and identify the facial nerve course. Follow the instructor's planned labyrinthectomy sequence so that the vestibular and canal anatomy remain understandable as they are opened. Do not treat the loss of recognisable labyrinthine structure as permission to proceed towards an estimated canal position.

The internal auditory canal is approached through its bony surroundings with continuing attention to the facial nerve, posterior fossa dura, jugular bulb and cochlear region. Exposure of the bony canal and opening of its dura are separate stages. Preserve the dural covering while establishing the extent and orientation of the canal. The route and its additional extensions have distinct anatomical costs. [9]

Understand the fundus

At the fundus, the facial and vestibulocochlear components occupy a structured arrangement that must be related to the view. In the usual fundal description, the facial nerve is anterosuperior, cochlear nerve anteroinferior, superior vestibular nerve posterosuperior and inferior vestibular nerve posteroinferior. This arrangement is a guide to identification, not permission to separate uncertain neural tissue. The view and orientation must be stated when naming a component.

Inspect bony crests and the entry of neural structures only as the preservation and selected exercise permit. The lateral end of the canal is a particularly confined region. Increasing the apparent exposure by uncontrolled bone removal can damage structures

before they are recognised. Reorient and obtain instructor confirmation when the relationship is unclear.

Open the dura only for an agreed objective

Dural opening is not necessary merely to demonstrate the bony corridor. If intradural anatomy is part of the session, plan the opening and the structures to be inspected before making it. Preserve the neural and vascular contents and avoid traction. A cadaveric nerve can be displaced without the immediate functional warning that would accompany injury in a patient.

Do not present tumour removal, facial-nerve dissection from a tumour or management of vascular adherence as simple extensions of this laboratory chapter. These require disease-specific technique, judgement and supervised clinical experience. The anatomical exposure provides a foundation, but it does not reproduce the pathology.

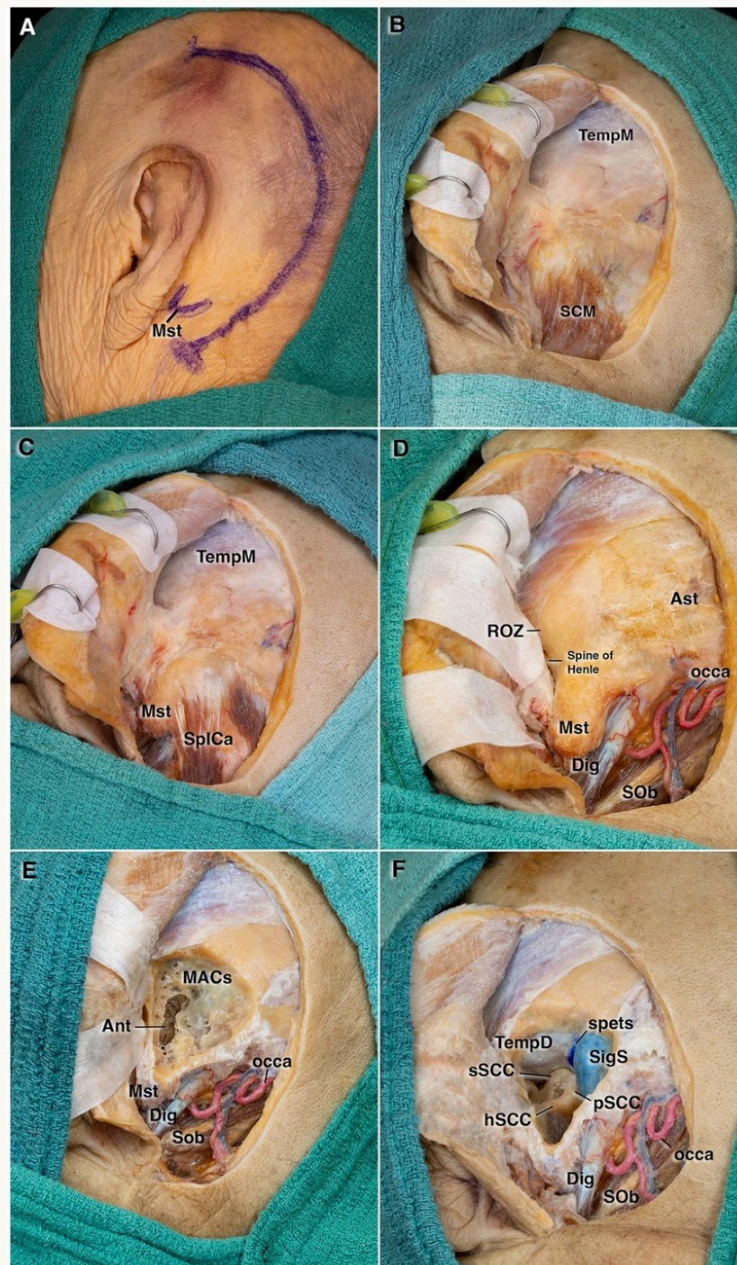
Account for closure and limitations

Discuss the routes by which cerebrospinal fluid could communicate with the middle ear and wound after an intradural exposure. The choice and execution of clinical closure depend on the approach and operative findings. Where soft tissues are absent, describe the missing reconstructive components instead of claiming completion of the operation.

At the end, identify the exposed canal, neural relationships and preserved boundaries. Record whether the dura was opened, which labyrinthine structures were removed and whether the cochlea or facial nerve was altered. A precise anatomical record is more useful than a general label such as “skull-base dissection completed”.

CHAPTER 15 / OPERATIVE PLATE 15.11

Translabyrinthine exposure: surface to labyrinth

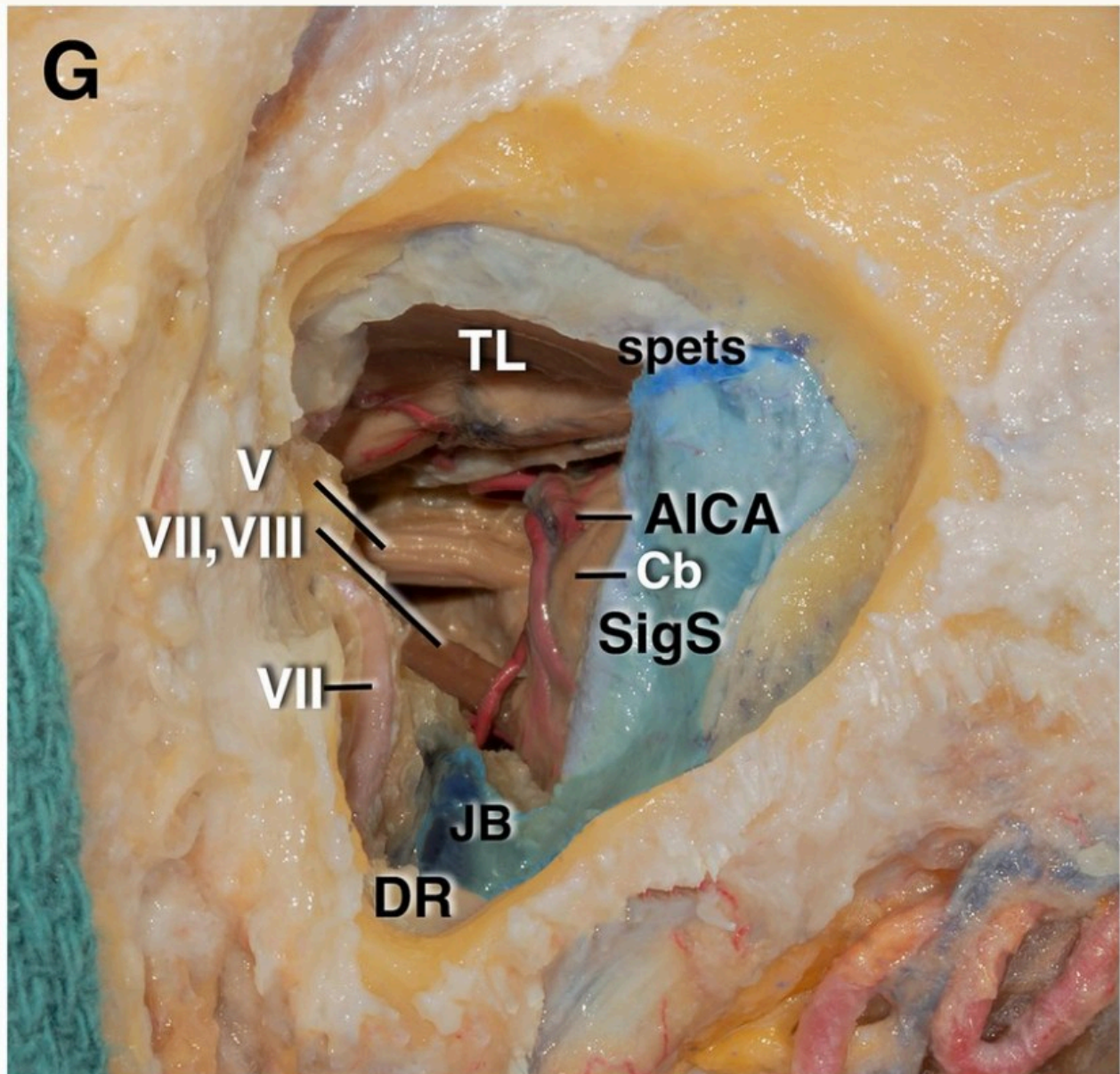


Panels A-F show the source cadaveric sequence from surface exposure to mastoid and labyrinthine boundaries. The advanced exposure is shown for study, not as a substitute for a supervised operative sequence.

Source figure 4A-F. Sevgi UT et al. Anterolateral, lateral, and posterior corridors to complex skull base lesions (2026). Front Neurol 17:1736101. CC BY 4.0.

CHAPTER 15 / OPERATIVE PLATE 15.12

Translabyrinthine exposure: deep relationships

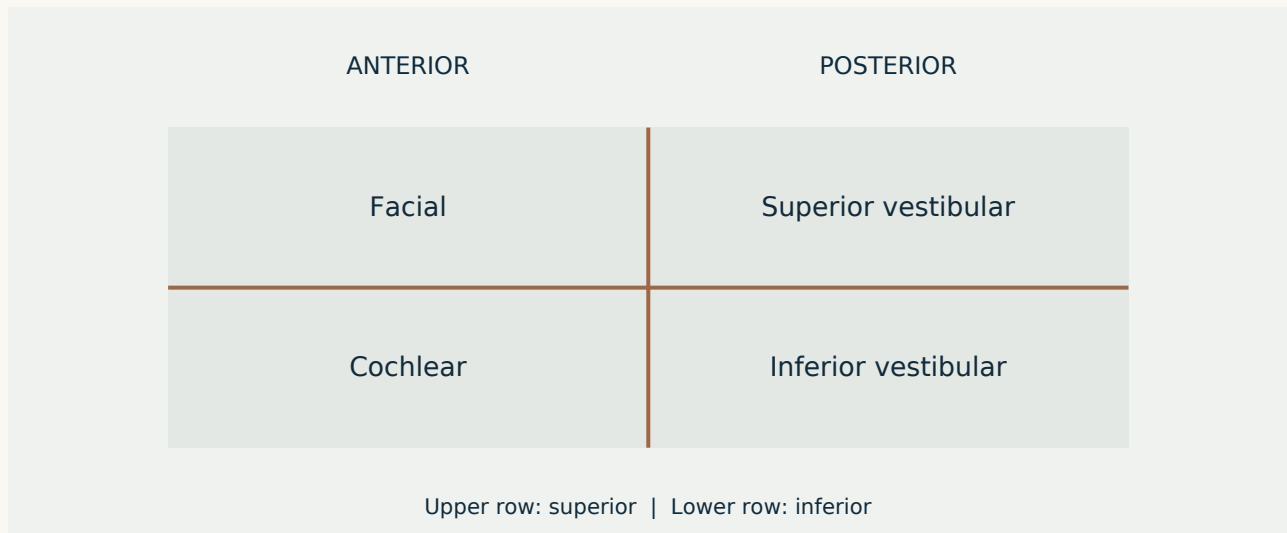


Panel G shows the completed deep exposure with cranial nerves, AICA, sigmoid sinus, jugular bulb and digastric ridge labelled. This is an advanced cadaveric endpoint after extensive removal of bone.

Source figure 4G. Sevgi UT et al. Anterolateral, lateral, and posterior corridors to complex skull base lesions (2026). Front Neurol 17:1736101. CC BY 4.0.

CHAPTER 15 / STUDY COMPANION

The fundus needs named directions



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Orientation	Anterior and posterior must be stated for the actual view.
Exposure	Bony canal exposure and dural opening are separate achievements.
Limits	A neural relationship drawing does not describe tumour dissection or closure.

Discuss at the specimen

What is lost if a fundal diagram is memorised without its orientation?

The names can be assigned to the wrong quadrants when the view changes. Re-establish anterior, posterior, superior and inferior before identifying components.

Record

Record dura status, removed labyrinthine structures and retained boundaries.

CHAPTER 16

The middle fossa and petrous apex

Select the route from the anatomy

The middle fossa and petrous-apex regions demonstrate how several important structures constrain a small volume of bone. Study them on a specimen that preserves the superior petrous surface and the relevant intracranial relationships. Review imaging before choosing a corridor, and recognise that some routes may not be available in a particular bone.

A petrous-apex lesion in a patient requires assessment of its nature, extent, symptoms and relationship to hearing and neurovascular structures. The aim may be drainage, biopsy, decompression or resection, each requiring a different plan. This chapter describes anatomical access and its limits rather than a universal operation for all apex lesions.

Orient on the middle fossa surface

Identify the petrous ridge, tegmen region and recognised foraminal landmarks. Relate the greater petrosal nerve and geniculate region to the superior petrous surface. The arcuate eminence is an orientation feature, but its correspondence with the superior semicircular canal is not exact in every specimen. Multiple landmarks and imaging should guide deeper interpretation. Cadaveric studies demonstrate variation in these surface-to-depth relationships. [8]

Elevate preserved dura carefully under the instructor's guidance, recognising attachments rather than stripping indiscriminately. Protect neural structures and avoid traction transmitted towards the geniculate region. Where dura or nerves have been removed during harvesting, label the limitation explicitly before using the specimen to demonstrate a surgical plane.

Relate the cochlea and internal auditory canal

The cochlea lies close to the lateral internal auditory canal and facial-nerve region. Its position must be accounted for during any superior petrous drilling. A geometric triangle drawn on the surface cannot guarantee that the deeper structures will fall at fixed angles or distances in every bone.

Expose only the region required by the selected exercise. Use progressive bone removal and correlate newly visible anatomy with the known map. When a deep boundary is uncertain, return to the surface and imaging relationships. Do not use a small burr to compensate for a large uncertainty about position.

Compare inferior routes to the apex

The infracochlear route is constrained by the cochlea above, the carotid artery anteriorly and jugular region posteriorly and inferiorly. The available space depends on the individual anatomy. A high jugular bulb or an unfavourable relationship can make the route unsuitable. Anatomical studies emphasise this variability rather than a universally available passage. [7]

An infralabyrinthine route passes below the labyrinth through a different set of relationships. Its feasibility depends on the labyrinth, jugular bulb, facial nerve and adjacent venous boundaries. Do not substitute one route's landmarks for another. Review the intended corridor on imaging and demonstrate each limiting structure before extending the exposure.

Where aerated tracts are present, they may help illustrate the connection to the apex. They do not establish a safe direction independently of the surrounding structures. In dense bone, an absence of cells should increase reliance on verified anatomy, not encourage an arbitrary deepening of the field.

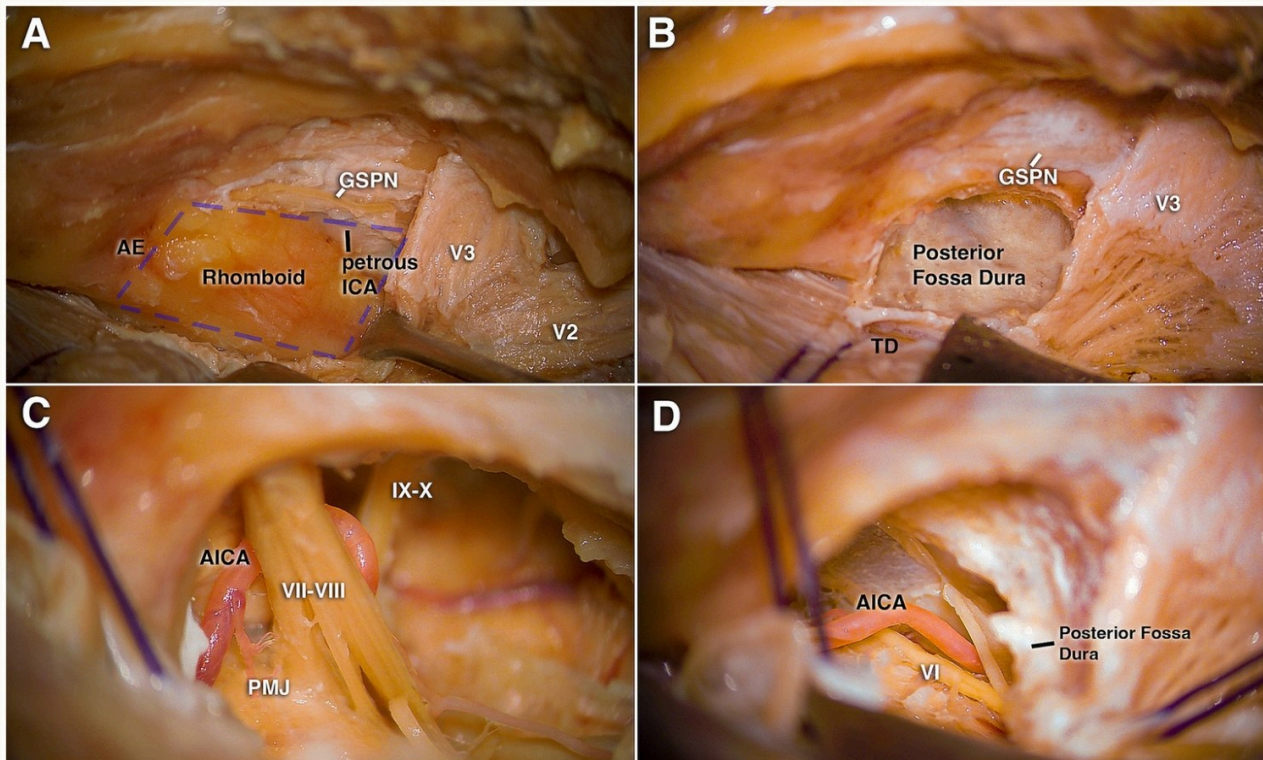
Complete the comparison

Describe which route was attempted, what part of the apex was reached and what remained inaccessible. Account for the structures preserved and any deliberately sacrificed to extend the view. A route that cannot be completed without unacceptable anatomical cost is a valid finding in a laboratory specimen.

Finish by comparing the superior and inferior perspectives. The aim is to understand how the same cochlear, neural and vascular structures constrain different approaches. The advanced value of the exercise lies in recognising those relationships and limits, not in producing the largest possible petrosectomy.

CHAPTER 16 / OPERATIVE PLATE 16.11

Middle-fossa and anterior petrous relationships

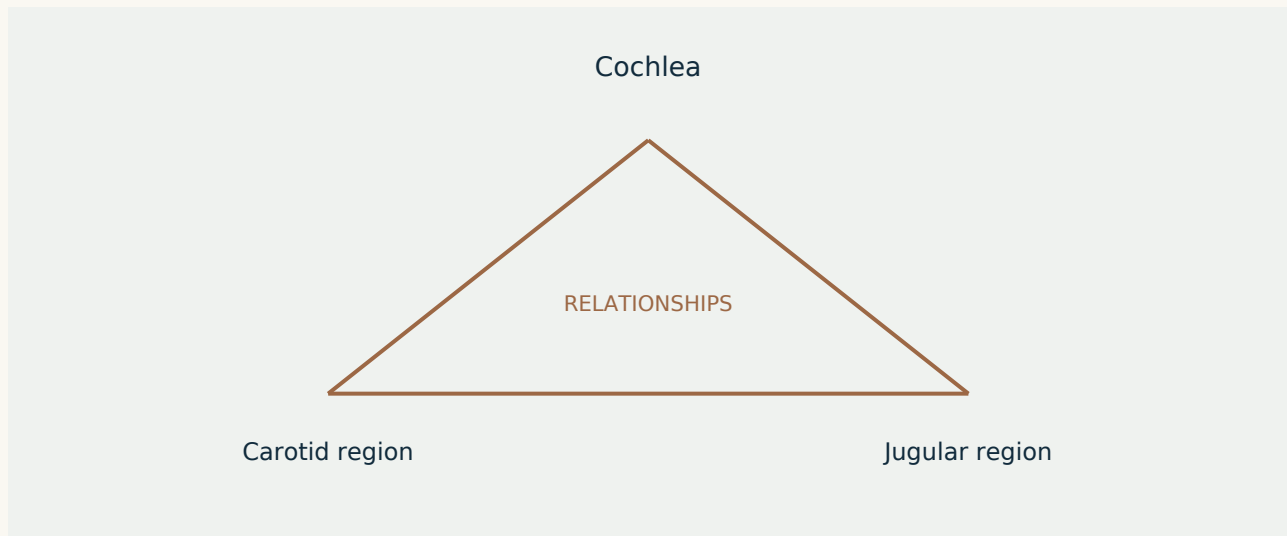


Panels A-D demonstrate the source anterior-petrosectomy exposure and deeper neurovascular relationships. This advanced comparative plate is not an infracochlear approach or a routine middle-fossa hearing-preservation procedure.

Source figure 3. Sevgi UT et al. Anterolateral, lateral, and posterior corridors to complex skull base lesions (2026). Front Neurol 17:1736101. CC BY 4.0.

CHAPTER 16 / STUDY COMPANION

A corridor is defined by its limits



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Superior route	Relate the petrous surface to the cochlea, facial-nerve region and canal.
Inferior route	Evaluate the limiting cochlear and vascular anatomy on the individual study.
Feasibility	An inaccessible corridor is a valid finding, not a reason for unplanned extension.

Discuss at the specimen

Does an aerated tract alone define a safe route to the petrous apex?

No. A tract must be interpreted within the surrounding cochlear, vascular and neural relationships. Its presence does not establish a safe trajectory.

Record

Name the structure that most restricts the attempted route in this specimen.

CHAPTER 17

Completion, complications and transfer to the operating theatre

Inspect the result systematically

At the end of any dissection, return to a broad view. Clear loose debris, restore orientation and review the intended objective. Inspect the canal wall or altered cavity, tegmen, sinus covering, ossicular chain, labyrinthine boundary and facial-nerve region as relevant to the procedure. A structure outside the final photograph still needs to be accounted for if it was placed at risk during the exercise.

Separate intended removal from unintended damage. Describe a structure as preserved only to the extent that it has actually been assessed. If a covering remained intact but the underlying nerve was not exposed, state that relationship accurately. Visual continuity does not prove function, and a dry specimen cannot demonstrate hearing or vestibular preservation.

Respond to an unintended breach

When a boundary is breached unexpectedly, stop the causative movement and obtain instructor review. Preserve the field long enough to identify the structure, extent and likely mechanism. Record whether the injury resulted from poor orientation, inadequate exposure, force, instrument contact, heat or an unrecognised variant. Continuing to drill may destroy the evidence needed to understand the event.

A dural opening, sinus injury, labyrinthine fistula, footplate displacement or facial-nerve injury has different implications in a patient. They cannot be reduced to a single repair instruction. In live surgery, immediate control, senior assistance, functional assessment and an appropriate repair or escalation plan depend on the injury and clinical circumstances. This manual does not prescribe an improvised rescue sequence from a cadaveric finding.

An error in the laboratory should prompt a targeted repeat exercise. If the cause was an unrecognised boundary, repeat identification and exposure on another suitable region or specimen. If it was unstable hand position, return to instrument control. Simply repeating the full operation without correcting the mechanism can reproduce the same error more quickly.

Evaluate performance beyond the finished cavity

Review preparation, orientation, instrument handling, preservation, recognition of difficulty and the final anatomy. A clean-looking endpoint may have been achieved with repeated unsafe contacts. Conversely, an appropriately stopped incomplete exposure may demonstrate sound recognition of a limit. Both the process and result should be discussed.

Use validated assessment tools when available and appropriate to the training programme. Do not invent a pass mark or a minimum number of bones and present it as proof of competence. Time can be recorded for context, but speed alone is not an acceptable definition of proficiency. The instructor should document specific skills that are established and those requiring further supervised practice.

Transfer learning to the patient carefully

Before clinical surgery, add the elements the laboratory cannot reproduce: the indication, patient priorities, hearing and vestibular status, facial-nerve function, infection or tumour extent, imaging, anaesthetic considerations, team preparation, consent and postoperative care. A familiar route may behave differently in diseased, scarred or previously operated tissue.

The learner's role should be agreed with the supervising surgeon. Identify which steps may be undertaken, the circumstances requiring a pause and how assistance will be requested. Direct supervision remains important when technical familiarity exceeds clinical experience. Knowing how to expose a structure does not establish when it should be exposed in a patient.

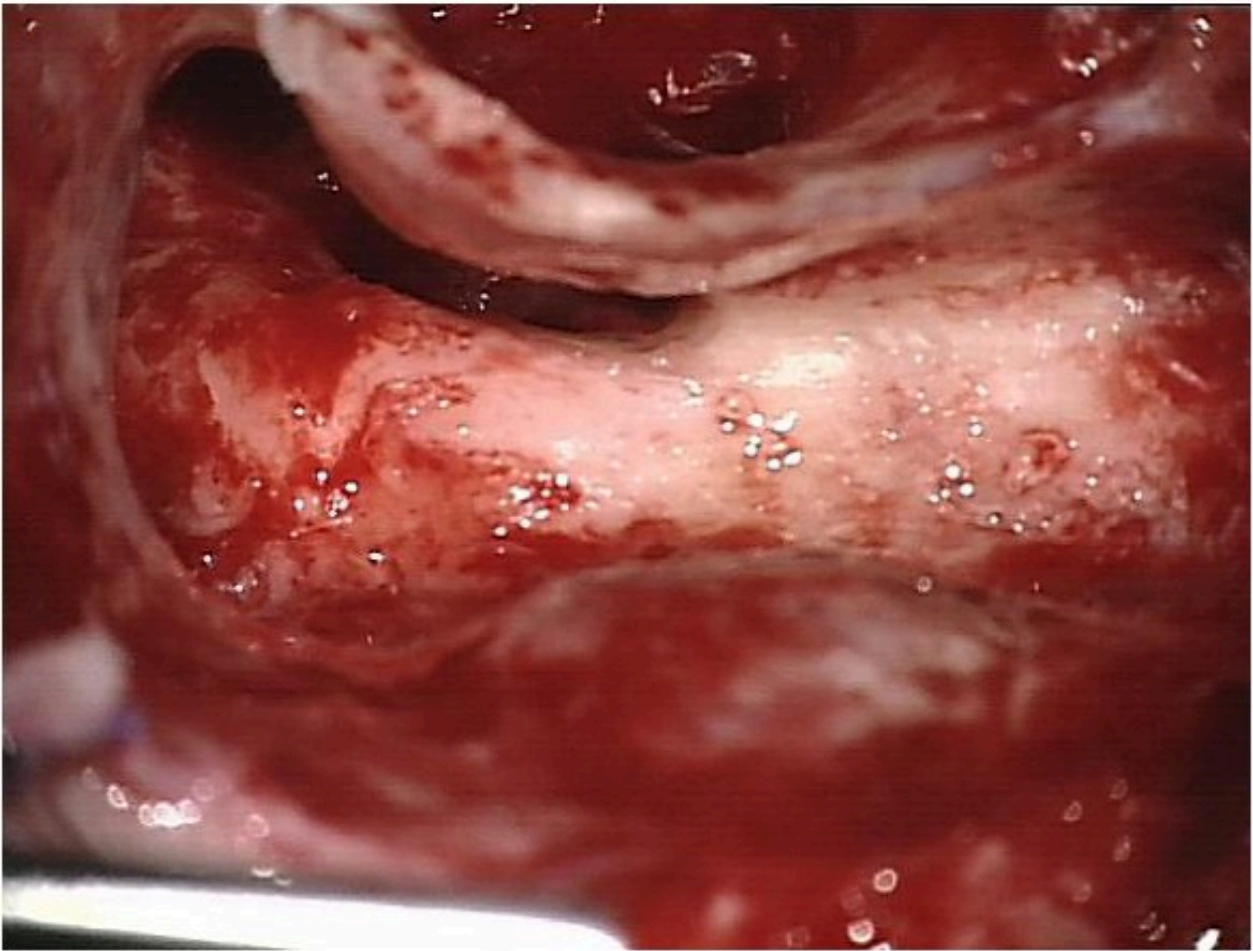
Keep a useful record

Write a short account of the specimen, procedure, preserved anatomy, intentional resections, unintended changes and instructor feedback. Include photographs with orientation and stage labels. Distinguish observed findings from interpretation and avoid retrospective descriptions that make an uncertain step appear certain.

The most useful final statement is specific: what was achieved, what was protected, what remains uncertain and what should be practised next. Over a series of specimens, this record should show increasing consistency of technique and anatomical recognition. It should also show the ability to recognise when the correct action is to stop and obtain help.

CHAPTER 17 / OPERATIVE PLATE 17.11

Inspect the completed field

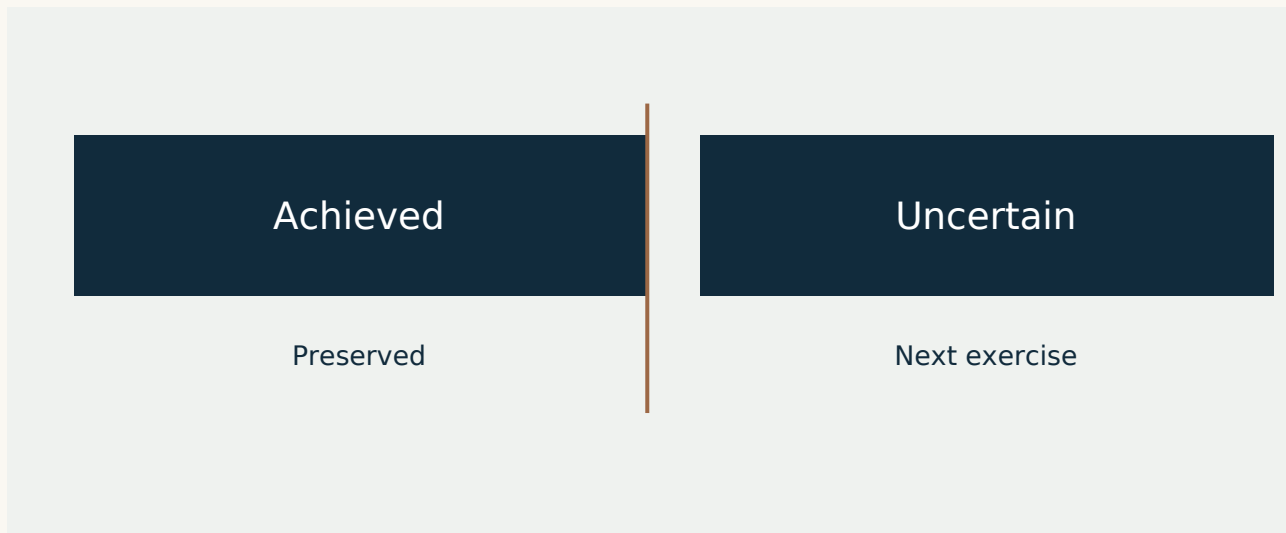


Source closed-cavity mastoidectomy endpoint. Use the view to structure a final record of boundaries and retained structures, rather than as a universal target shape.

Source figure 24. Harris T, Linder T. Mastoidectomy and Epitympanectomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

CHAPTER 17 / STUDY COMPANION

A useful record distinguishes four things



Conceptual teaching graphic. Not a specimen view, CT image, scale drawing or drilling guide.

Observation	Record the actual exposure and method of inspection.
Interpretation	Separate a finding from its presumed mechanism.
Transfer	Add clinical indication, function, disease and supervision before theatre work.

Discuss at the specimen

Why can an appropriately stopped incomplete exposure be educationally valuable?

It can demonstrate recognition of an anatomical or technical limit. Assessment must consider the process and preserved structures as well as the final appearance.

Record

Write one specific repeat exercise linked to the observed difficulty.

Appendix A Dissection record

Use one record for each specimen and retain photographs with the same identifier.

Specimen or model identifier:

Date and specimen side:

Preservation method and pre-existing defects:

Imaging available and identity confirmed:

Planned procedure and agreed extent:

Structures to preserve:

Exposure actually completed:

Anatomical variations observed:

Structures intentionally removed or opened:

Unintended changes and their likely mechanism:

Method of assessing the final result:

Photograph references with orientation and stage:

Instructor feedback:

Specific exercise to repeat or develop next:

Learner and instructor names:

Appendix B Terminology

Antrum: the mastoid space communicating with the epitympanum through the aditus.

Atticotomy: an opening made to expose the epitympanic region. Its extent should be described rather than inferred from the term alone.

Canal wall up: a mastoid approach retaining the posterior bony canal wall; the associated middle-ear and reconstructive work should be specified separately.

Canal wall down: a mastoid approach in which the posterior canal partition is removed to create a common cavity; the term does not describe every component of the reconstruction.

Dehiscence: an absence of expected bony covering. Distinguish a presumed anatomical defect from an iatrogenic or harvest-related defect.

Facial recess: the corridor related to the mastoid facial nerve, chorda tympani and incus buttress through which posterior tympanotomy may be performed.

Fenestration: creation of an opening. State the structure, purpose and extent.

Labyrinthectomy: intentional opening or removal of labyrinthine structures; a function-sacrificing procedure in clinical use.

Posterior tympanotomy: transmastoid opening into the middle ear through the facial recess.

Round-window niche: the bony recess surrounding the round-window membrane; it is not synonymous with the membrane itself.

Saucerisation: shaping the access to a cavity to improve visibility and instrument approach while respecting its anatomical limits.

Skeletonisation: definition of a structure through controlled removal of adjacent bone; it need not imply removal of every protective bony layer.

Stapedotomy: creation of a small footplate opening for the selected reconstruction, distinct from a larger footplate removal.

Tegmen: the bony roof separating the relevant middle-ear or mastoid region from the middle cranial fossa.

References

Selected anatomical and technical reading. Online resources accessed 25 October 2026. Equipment and clinical protocols should be checked in their current versions before use. The references support particular anatomical descriptions and provide further reading; they do not constitute independent validation of this manuscript.

[1] Hua X. Temporal Bone Anatomy Cadaveric Dissection. Iowa Head and Neck Protocols. University of Iowa. Published 9 May 2018.

<https://iowaprotocols.medicine.uiowa.edu/protocols/temporal-bone-anatomy-cadaveric-dissection>

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Further visual reading: Jackler RK, Gralapp CL. Otologic Surgery Atlas. Stanford University. Relevant sections include middle ear and mastoid anatomy, ossiculoplasty, facial nerve, vestibular surgery and petrous apex.

<https://otosurgeryatlas.stanford.edu/>

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Figure 6.1 · Surface orientation · page 32

Figure 6.2 · Cortical opening · page 33

Figure 6.3 · Saucerisation · page 34

Figure 6.4 · Superior and posterior relationships · page 35

Figure 7.1 · Antral starting view · page 39

Figure 7.2 · Retained landmarks · page 43

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MASTOID

Harris T, Linder T. Mastoidectomy and Epitympanectomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

Ch 5: fig 8, Ch 8: fig 20, Ch 10: fig 28, Ch 10: fig 29, Ch 13: fig 19, Ch 13: fig 23, Ch 14: fig 18, Ch 17: fig 24

ENDO

Tarabichi M. Endoscopic cholesteatoma, tympanoplasty and middle ear surgery (2013). UCT Open Access Atlas. CC BY-NC 3.0.

Ch 2: fig 1, Ch 4: fig 3, Ch 7: fig 10, Ch 7: fig 14, Ch 7: fig 18, Ch 9: fig 9

STAPES

Harris T, Linder T. Incus and malleostapedotomy, stapedectomy, stapedotomy (2012). UCT Open Access Atlas. CC BY-NC 3.0.

Ch 2: fig 5, Ch 5: fig 6, Ch 12: fig 12, Ch 12: fig 17, Ch 12: fig 18

OSSICULO

Harris T, Linder T. Ossiculoplasty (2012). UCT Open Access Atlas. CC BY-NC 3.0.

Ch 11: fig 3, Ch 11: fig 5, Ch 11: fig 7

LATERAL

Mathew R, Harris T, Patel P. Lateral temporal bone resection surgical technique (2019). UCT Open Access Atlas. CC BY-NC 3.0.

Ch 3: fig 1, Ch 3: fig 2

FRONT

Sevgi UT et al. Anterolateral, lateral, and posterior corridors to complex skull base lesions (2026). Front Neurol 17:1736101. CC BY 4.0.

Ch 1: fig 1, Ch 14: fig 7A, Ch 15: fig 4A-F, Ch 15: fig 4G, Ch 16: fig 3

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<https://vula.uct.ac.za/access/content/group/ba5fb1bd-be95-48e5-81be-586fbaeba29d/>

Sevgi UT and colleagues: <https://doi.org/10.3389/fneur.2026.1736101>

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Editorial review and source checks

REVIEW RECORD / 25 OCTOBER 2026

This record distinguishes an editorial source comparison from independent specialist review. The checks below concern selected relationships and wording; they do not certify the whole manual or the accuracy of every label in the supplied artwork.

Checks completed

Manuscript continuity

All seventeen chapters retained. The expanded Chapters 6 and 7 replace their earlier shorter versions. Figure-production placeholders are removed; operative prose is preserved.

Visual coverage

Twenty-nine credited source plates and seventeen conceptual study graphics are retained. Six pilot illustrations are omitted pending source and rights confirmation. No simulated CT scans or fabricated cadaver photographs are presented.

Mastoid orientation

Compared the treatment of variable septa, tegmen and sinus relationships with Iowa's cadaveric dissection resource [1]. Identification remains based on corroborating landmarks, not colour or a fixed depth.

Terminology

Compared the distinction between epitympanotomy and epitympanectomy and the need to describe the extent of mastoid surgery with Harris and Linder [2]. These terms do not substitute for an operative description.

Petrous-apex limits

The infracochlear relationship to cochlea, carotid and jugular structures is consistent with the published clinical description by Plontke and colleagues [11]. This does not establish feasibility for a particular specimen.

Reference integrity

References are further reading, not endorsements. The Stanford atlas requires permission for publication of its illustrations; none has been reproduced here. Device instructions and local protocols are not replaced by this manual.

Independent review status

Specialist reviewer: Dr SPS Yadav, identified by Dr Bhushan Kathuria. Specialist verification was confirmed by the author on 25 October 2026. The 29 later source plates are a separate editorial selection, not a claim of further independent specialist sign-off. Source attribution does not imply endorsement.

[11] Plontke SK and colleagues. The infracochlear approach for diagnostic petrous apex surgery. 2019. PubMed PMID 31187150. <https://pubmed.ncbi.nlm.nih.gov/31187150/>

Topic finder

Chapter references keep this guide useful across revised page layouts. Use the linked contents to open the corresponding chapter.

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WITHIN THE TEMPORAL BONE

Anatomy, technique and surgical judgement

A surgeon's companion to temporal bone dissection

Seventeen chapters bring together preparation, anatomical orientation, supervised dissection and selected lateral skull-base exposures. Study companions, discussion prompts and credited published plates support careful reading before, during and after laboratory learning.

For residents, fellows and surgeons developing a thoughtful, structured approach to temporal bone study.

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