



NIDCD NATIONAL TEMPORAL BONE, HEARING AND BALANCE PATHOLOGY RESOURCE REGISTRY

Guidelines for Removal of Temporal Bones for Pathological Study

The temporal bones should be removed as soon as possible. If the body is not refrigerated, removal should take place within eight hours. If the body is refrigerated, they should be removed within 12-36 hours. If the body is embalmed, the bones can be removed up to several days or even weeks after death.

The most commonly used method of removal of temporal bones is the intracranial technique. The brain is removed first and then the temporal bone on each side is removed. *Note:* Before the brain is removed, the seventh and eighth cranial nerve trunks should be purposely cut at the entrance of the internal auditory canal (porus acousticus) to avoid traumatic avulsion from the internal auditory canal. See the following pages for details.

Images and video clips explaining the removal process are available on our website:

<http://research.meei.harvard.edu/otopathology/tbimages/tbremoval.html>

If a brain autopsy is not feasible, then remove the temporal bones by the extracranial (lateral) technique, which is described on page 7.

The right and left temporal bones should be placed immediately into jars containing 400cc of 10% neutral buffered formalin. If the brain has been removed, it should also be fully submerged in a container with plenty of 10% neutral buffered formalin. The specimens should then be refrigerated (if available) in the formalin solution for 7 days. If no refrigeration is available, room temperature will be fine. Allow the specimens to soak for about one week before shipping.

Specimens should be shipped in formalin soaked gauze, bagged and then placed into watertight containers with the tops securely taped. Shipping materials (box, jars, watertight bags, and labels) will be forwarded to you.

If the specimens are severely damaged during removal, the Registry and its collaborating laboratories exercise the option to not accept them.

Temporal bone specimens should fit the following criteria:

1. The entire middle ear and inner ears must be intact.
2. Most of the mastoid should be present.
3. Some external auditory canal should be present.
4. The trunks of the seventh and eighth cranial nerves should be visible at the entrance of the internal auditory canal (indicating that the nerve trunks are intact within the temporal bone.)

If you have any questions, please contact the Registry, 24 hours a day at (800) 822-1327.

THANK YOU FOR YOUR COMMITMENT TO THE ADVANCEMENT OF DEAFNESS RESEARCH

INTRACRANIAL TECHNIQUE OF TEMPORAL BONE REMOVAL

The temporal bone forms part of the lateral wall and floor of the skull. The middle and inner ear structures lie within the temporal bone. The brain is removed first and then the right and left temporal bones are removed separately by either the block method or the bone plug method*.

* Please review images and video clips of the Removal Process on our website:

<http://research.meei.harvard.edu/otopathology/tbimages/tbremoval.html>

REMOVAL OF THE BRAIN:

The brain is elevated from the floor of the skull sufficiently to expose the trunks of cranial nerves VII and VIII. These must be cut at the entrance of the internal auditory canal.

Note: Failure to do this will frequently result in avulsion of these nerves from the canal, which detracts from the value of the specimens.

REMOVAL OF THE BRAINSTEM:

The brain stem should also be removed, if this is included in the donation.

Note: If unsure of how to separate the brain stem from the cerebellum, it is better to send the entire brain intact to avoid destroying the cochlear nucleus when removing the cerebellum.

STORAGE OF BRAIN AND BRAIN STEM:

Brain tissue should be placed in **cold 10% neutral buffered formalin** (fully submerge and cover specimen.)

METHOD OF TEMPORAL BONE REMOVAL:

The equipment needed is shown in Figure A. The **right and left** temporal bones can be removed by either the **block** or **bone plug method**. Both methods use a Stryker autopsy saw which is standard equipment in autopsy rooms. (Figure A)

LOCATION FOR DRILLING:

The arcuate eminence which locates the superior semicircular canal, is identified as a prominence on the superior surface of the petrous bone and locates the center for the specimen to be removed.

BLOCK METHOD:

Making the Cuts (Please see Fig. B)

Four cuts are made in the bone of the skull base on both the right and left side.

- **Cut 1** is made in the lateral part of the floor of the middle cranial fossa and passes through the cartilaginous part of the external auditory canal and lateral aspect of the mastoid bone.
- **Cut 2** is made at the petrous apex perpendicular to the pyramid.
- **Cut 3** is made parallel to and 2 inches anterior to the petrous ridge.
- **Cut 4** is an undercut of the block of tissue outlined by the preceding 3 cuts. It is made in the floor of the posterior cranial fossa parallel and adjacent to the petrous pyramid.

BLOCK METHOD:

Removing blocks (left & right side)

- The block is engaged with a bone grasping forceps and forcibly retracted.
- The internal carotid artery is identified and grasped with a hemostat, after which an osteotome scissors or knife is used to sever the remaining fibrous and ligamentous attachments.
- **Care should be used to avoid crushing the specimen with the bone grasping forceps.**
- The internal carotid artery is ligated and the external auditory canal is closed by suture or suitable clamp.

BONE PLUG METHOD

(Please see Fig. B to see positioning of bone plug cutter.)

This method consists of using the bone plug cutter in the oscillating motor driven saw. For the adult body, the proper saw diameter is 1^{1/2} inches.

- The saw is centered on the arcuate eminence and is advanced through the skull base perpendicular to the floor of the middle cranial fossa.
- The head should be steadied by an assistant.
- The cutter can be irrigated with normal saline to improve its cutting action.
- A loss of resistance is felt when the cutter has traversed the skull base.
- The bone plug is grasped with bone forceps and gradually extracted by forceful pulling and rotating of the bone plug.
- The carotid artery is identified and grasped with a hemostat, following which the inferior attachments of the specimen are severed with knife, scissors or osteotome. The internal carotid artery is ligated and the external auditory canal is closed by suture or suitable clamp.

BONES WITH COCHLEAR IMPLANT:

(Please see Fig. C)

When a temporal bone has a cochlear implant, an additional step is needed initially prior to removing the bone. This additional initial step consists of cutting the electrode array within the mastoid portion of the temporal bone and is explained in Figure C.

FIXATION:

After removal, the left and right temporal bones should each be placed into jars containing **400cc of 10% neutral buffered formalin**. The brain should be fully submerged in a container with plenty of cold 10% neutral buffered formalin. Please refrigerate (38-40° F, 4° C) the specimens in the formalin solution for one week if possible. If no refrigeration is available allow the specimens to soak in the solution for about a week prior to shipping.

SHIPPING:

The specimens should be wrapped in formalin soaked gauze and placed into watertight bags. The bagged specimens are then placed into containers with the tops securely taped to prevent any leakage. A box with appropriate containers and bags will be sent to you. Please label the container “**diagnostic specimens**”

Please have the specimens shipped via Federal Express to:

Diane Jones
Otopathology Department
Massachusetts Eye and Ear Infirmary
243 Charles Street
Boston, MA 02114-3096
(617) 573-3534

The Federal Express account number is: **1641-6187-7**

If you have any questions, please call the Registry on our 24-hour hotline at (800) 822-1327

Thank you, your time and assistance is greatly appreciated.

DETAILED DESCRIPTION OF REMOVAL TECHNIQUES:

A more detailed description of techniques of temporal bone removal is contained in the following publication: Nadol JB Jr. *Techniques for human temporal bone removal: information for the scientific community*. Otolaryngol Head Neck Surg. 1996 Oct;115(4):298-305.

Figure A: Instruments needed to remove temporal bones

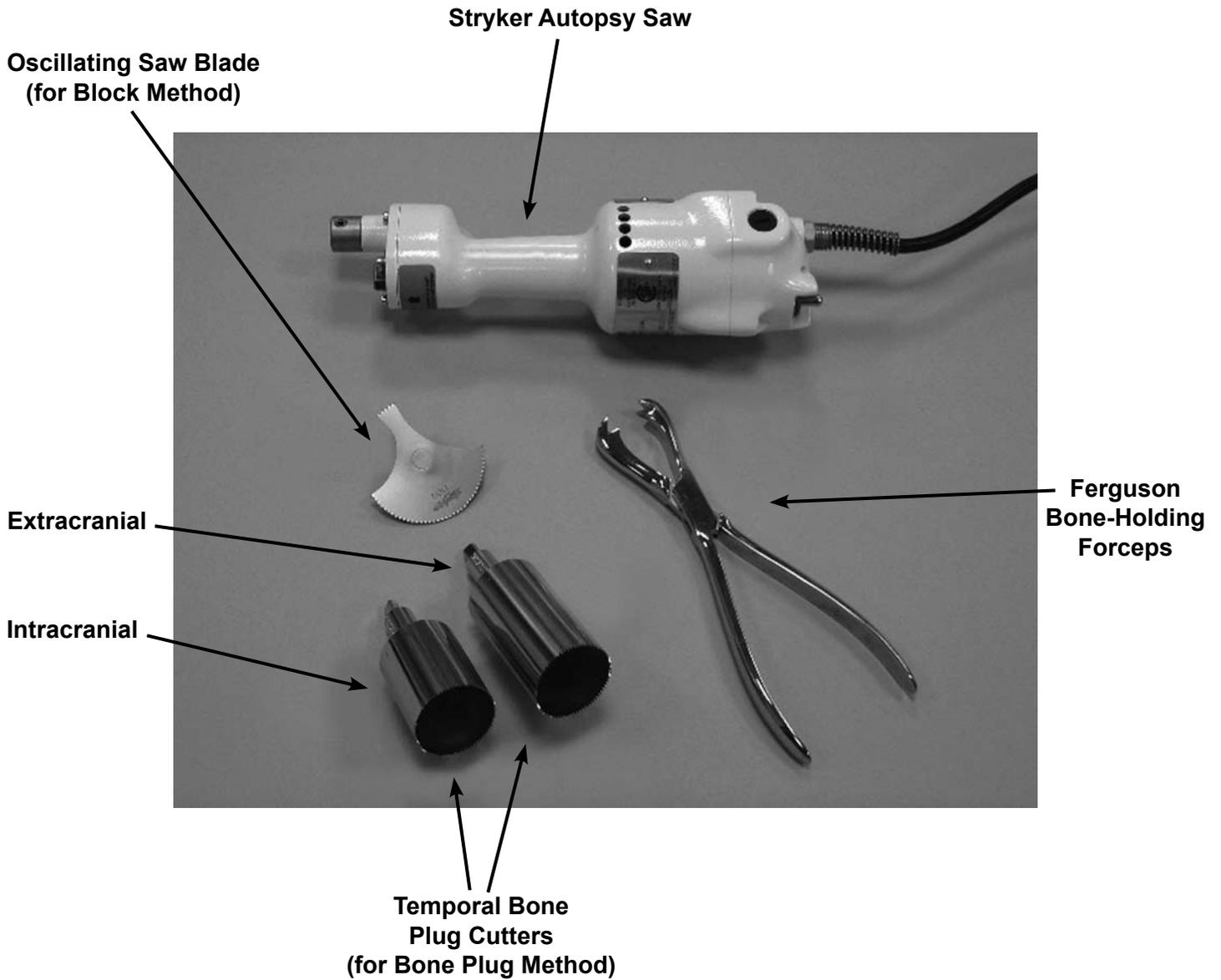
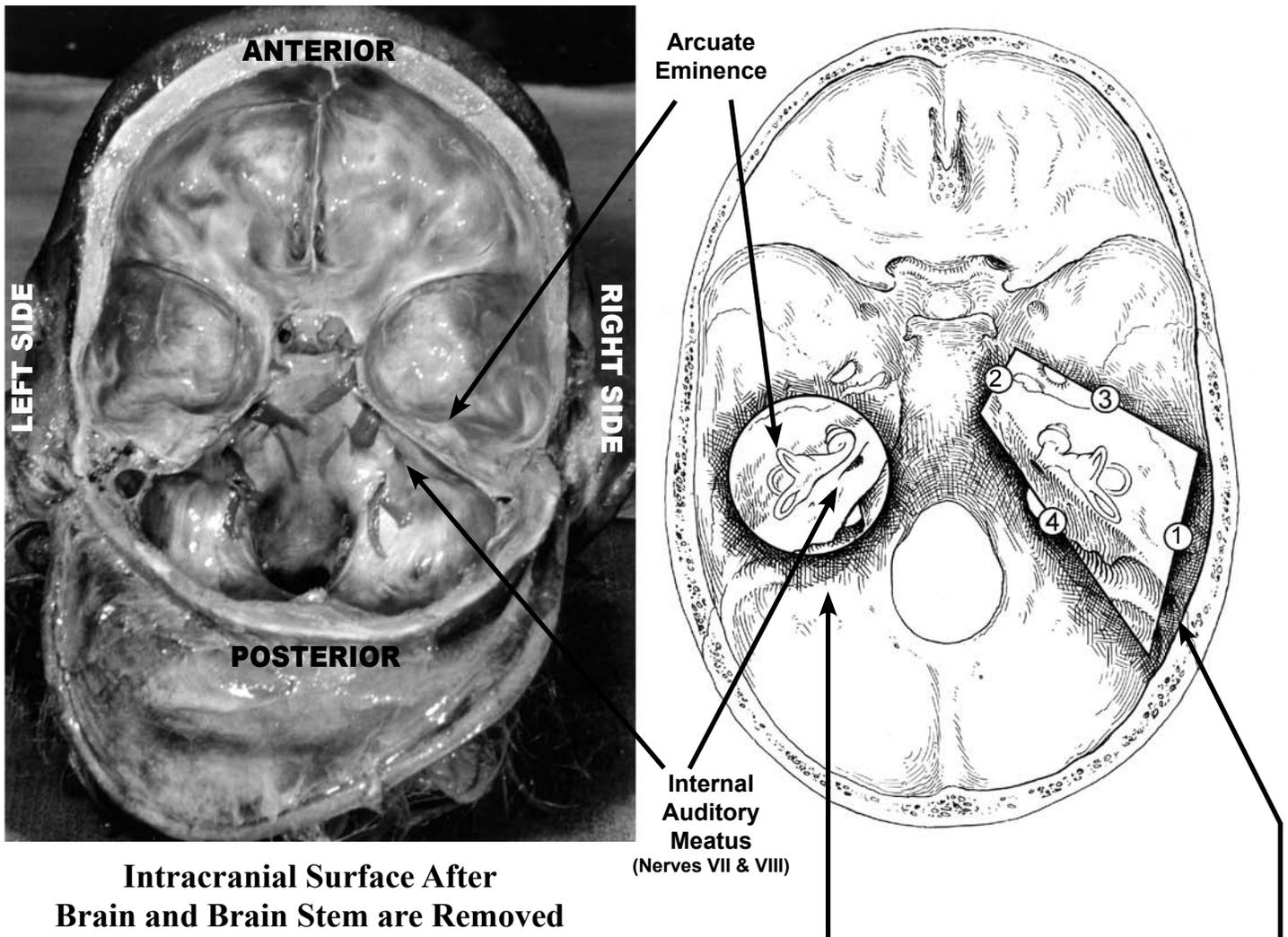


Figure B: Two Methods of Temporal Bone Removal

NOTE: Please be sure to remove both the right and left temporal bones



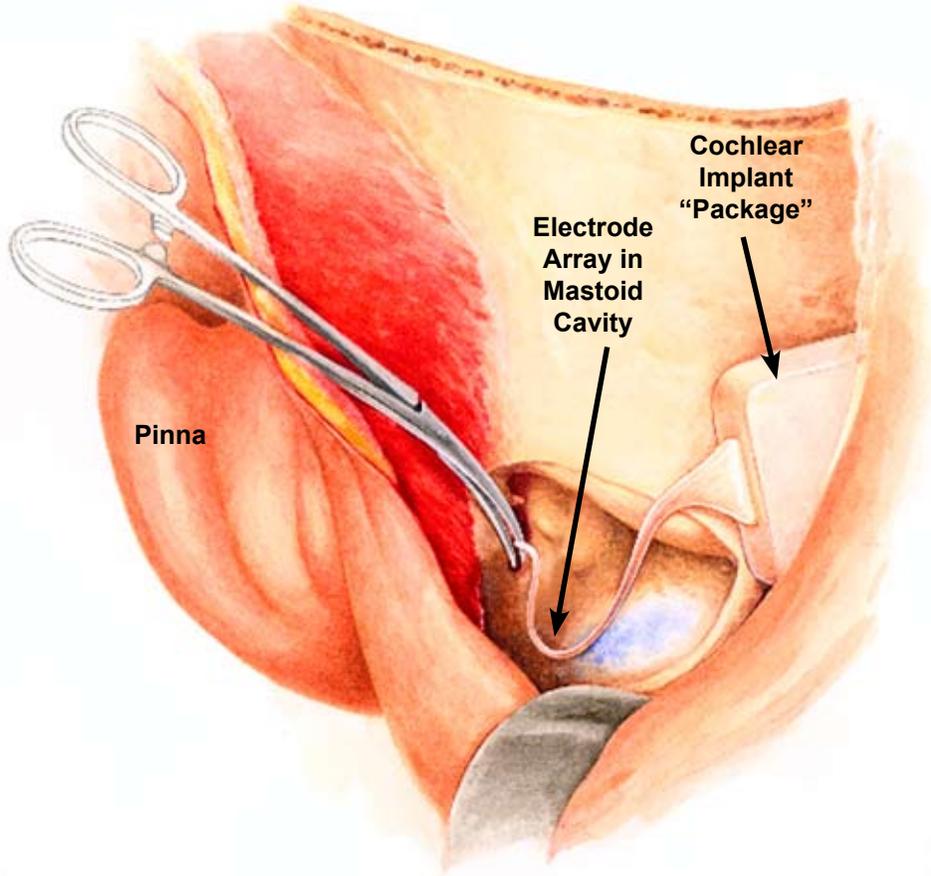
**Intracranial Surface After
Brain and Brain Stem are Removed**

PLEASE NOTE: Diagram shows minimum size of cuts. It is better to make the cuts wider thereby taking a larger specimen. Please be sure to remove both the right and left temporal bone. It is fine to use the same method of removal for both.

Figure C: Removal of Temporal Bones with a Cochlear Implant

After removal of the skullcap and brain, dissect subcutaneously in the postauricular region to identify the cochlear implant package (a flat disc approximately one-inch in diameter.) From the front part of this package exits the electrode array that is shaped like a noodle. The array goes through the mastoid cavity into the middle ear and then into the inner ear. Identify and sharply cut the array deep in the mastoid cavity with a pair of heavy scissors. This will disconnect the package from the electrode array going into the cochlea. The package is unimportant, is not studied, and should not be removed. On the other hand, the electrode array within the cochlea is of great interest, and it should be left in-situ for histologic sectioning. ***Do not pull on the electrode array! It must remain within the inner ear!*** Once the array is disconnected from the package, the temporal bone can be removed in the usual fashion.

Please remove the opposite ear temporal bone so that it can serve as a control for histologic studies.



EXTRACRANIAL TECHNIQUE FOR TEMPORAL BONE REMOVAL

Use this method if a brain autopsy cannot be done. This technique requires a special extracranial bone plug cutter, which is shown in Figure A. Note that this extracranial cutter is longer than the standard intracranial cutter.

1.) A standard postauricular incision is made through all soft tissue to the lateral mastoid cortex. 2.) The soft tissue is retracted with a periosteal elevator, and the cartilaginous canal transected at the level of the bony external meatus with a knife blade. 3.) The centering and direction of the plug cutter during removal is critical. The circular saw is centered on the external auditory canal and directed on an imaginary line through both external auditory canals. It is essential that the most superior aspect of the plug cut extend above the temporal line so that the floor of the middle cranial fossa and the most superior aspects of the membranous labyrinth are preserved. 4.) Along an imaginary line drawn through both external auditory canals, the plug cutter is advanced to its full depth of 5.75cm bringing the most medial aspect of the cut just beyond the midline and into the basisphenoid and basiocciput. The temporal bone will usually disarticulate along the petrooccipital and petrosphenoid suture lines and can be easily removed in the plug cutter. The opposite temporal bone is removed by repeating the procedure on the opposite side. If disarticulation is not readily achieved, the introduction of the plug cutter from the opposite side before attempting plug removal will completely transect the skull base and thus facilitate removal of both bones. 5.) The dotted line indicates the centering of the plug cutter. The external meatus is approximately at the center of the plug cut. It is critical that the superior aspect of the cut is above the temporal line to include the floor of the middle cranial fossa.

