Congenital Aural Atresia

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Congenital aural atresia is a condition that involves the ear canal, and where the external auditory ear canal to the middle ear ossicles is absent or closed. This surgical procedure, which allows a child to hear, involves drilling into the temporal bone and placing a layer of skin over the newly made canal to allow sound to reach the middle ear.[1] Another procedure commonly associated with atresia is microtia. Microtia reconstructs the external auricle.

This birth defect may affect the ossicles (middle ear bones – malleus [hammer], incus [anvil], and stapes [stirrup]), ear canal and external auricle. There are four grades. Grade 1 is when the external ear is smaller than normal and the ear has mostly normal anatomy. Grade 2 is when part of the ear looks normal, usually the lower lobe, although the canal may be normal, small or completely closed. Grade 3 is when the ear has "peanut-shaped" skin and cartilage, and there is no canal. Grade 4 is when there is a complete absence of both the external ear and ear canal.[2]

The Jahrsdoerfer grading scale is a valuable tool in the preoperative evaluation of these patients.[3] A preoperative temporal bone CT scan is performed and evaluated.[4] Nine critical areas of temporal bone anatomy are given a number. These are the Jacobson nerve, incus, stapes, footplate, pedial tendon, chordae timpita, malleus, oval window and facial nerve.

LEARNING OBJECTIVES

- Review the anatomy associated with congenital aural atresia
- Examine the seven essential steps to this procedure
- Recall the set up and draping protocols specific to this procedure
- List the considerations on the Jahrsdoerfer grading scale
- Explain how the procedure allows for a child to hear for the first time

The stapes is given two points and the other entrees are given one point.

Parameter	Points
Stapes present	2
Oval window open	1
Middle ear space	1
Facial nerve normal	1
Malleus-incus complex present	1
Mastoid well pneumatized	1
Incus-stapes connection	1
Round window normal	1
Appearance of external ear	1
Total available points	**10**

The best score is 10. If a patient scores six or more, he/she is a candidate for surgery. With a score of five or less, the complications outweigh the potential benefits.6 Prompt diagnosis and early assessment of hearing helps to avoid the late sequelae of speech problems.[7]

Surgery to open the ear canal and restore the natural sound by conducting a pathway of the ear canal and middle ear to the inner ear (cochlea, which is usually healthy in these children) is a challenging operation that is performed in a single stage generally taking about four to five hours. There are essentially seven steps to the operation:

1. Skin incision, fascia graft harvest, exposing the cortex of the temporal bone
2. Drilling the bony canal, releasing the ossicles, examining the ossicular motion
3. Harvesting the split thickness skin graft
4. Placing the temporalis fascia graft as the new eardrum
5. Placing the split thickness skin graft to line the bony canal
6. Meatoplasty – creating an opening in the outer ear for the skin graft; connects the bony canal to the outside world
7. Delivering the skin graft through the newly created meatus, suturing the edges of the skin graft to the edge of the native skin of the concha, closing the post auricular incision

PREP AND DRAPING

The back table preparation typically will take the surgical technologist about 30 minutes. About eight small pea-shaped pieces of cotton will be placed into 1.5 ml of epinephrine 1:1000 dilution for hemostasis. The remaining 0.5 ml of epinephrine will be added to 20 ml of 1% Lidocaine plain in 3 cc syringe and 27-gauge hypodermic needle that will make a dilution of 1:40,000 for local anesthesia. Triamcinolone acetonide will be placed in a tuberculin syringe with a 27-gauge hypodermic needle to prevent an inflammatory reaction. An ofloxacin otic solution will be dispensed in a 3 cc syringe and 23-gauge hypodermic needle to inflate the ear canal dressing sponges. Silastic sheeting, that is 0.04 mm thick, will be cut into circles 4 mm-7mm for holding the skin graft against the canal. The four ear canal sponge dressings will be cut with a knife to two-thirds of the length leaving five whole-length sponges for holding the skin graft in place. A plastic skin carrier will be cut to one-third length for preparation of the skin graft. Three metal medicine cups will be filled ¾-full with warm lactated ringers to rinse the skin graft. A 3-0 absorbable suture will be used to close the post-auricular incision. A 4-0 absorbable suture will be used to anchor the anterior conchal flap. A 5-0 fast-acting tissue suture will be used to anchor the skin graft to the skin at the canal's new edge. The skin harvest dressing will involve a Xeroform gauze cut to size, a non-adherent gauze cut to size, three 4x4 gauze dressings and a gauze roll that will hold the dressings in place. This will be applied to either the upper extremity or lower extremity. The ear dressing will start with a cotton ball covered in bacitracin ointment, a non-adherent dressing cut into a crescent shape to wrap around the auricle, five 4x4 gauzes folded over to cover the incision, two unfolded 4x4 gauze to cover the auricle, 10-inch gauze roll strips to hold the dressings off of the eye, three gauze rolls to wrap the dressings around the head and a cloth towel for under the patient's head while wrapping to keep the dressings clean.

The instruments will be set up like any ear case with some additional pieces. A #7 knife handle will be used with the #11 knife blade for the meatoplasty. Two smooth jewelers' forceps will be used to handle the skin graft during preparation and placement. Two plastic white cutting blocks will be used to prepare the skin graft and to place the fascia graft under the overhead light for drying. A larger cutting block will be used to save cut up muscle tissue pieces to anchor the edge of skin graft to any air cells present in the canal after the graft is placed. A moistened angled ball probe

will be used to position the skin graft in the canal. Bayonet bipolar forceps will be used for hemostasis. Three metal medicine cups will hold lactated ringers for rinsing skin graft. Two dental excavators of different sizes will be used to remove the remnants of bone on the middle ear ossicles. Mineral oil will be applied to the edge of the dermatome, the desired blade will be attached, more oil will be applied to the metal edge and a 2-inch 5.2 cm guard will be loaded. The surgical technologist will need to ensure the guard is hand tight but not too tight and not too loose, as the blade needs to rotate back and forth freely.




There are four grades of congenital aural atresia, shown from left: Grade 1 - external ear is smaller than normal and the ear has mostly normal anatomy; Grade 2 - external and internal ear may be smaller; Grade 3 - "peanut-shaped" sking and cartiledge with no canal; Grade 4 - complete absence of external ear and ear canal.

Photos provided by Bradley Kesser, MD

After induction of general anesthesia, the operating table will be turned 180 degrees. The patient's head will be away from the anesthesia provider and the surgeon, placed in a bit of extension and lies on a foam headrest. The pre-operative preparation will include neuro-monitoring electrodes taped to the patient, shaving any excess hair along the incision site, taping back the patient's hair so it will not fall into incision, placing clear unsterile steri-drapes around the surgical site and prepping the site with an antiseptic scrub and solution.

Draping will start with four cloth towels, a skin stapler and a split sheet. To direct fluids from the field into a lined kick bucket, two Allis clamps and an unfolded cloth towel will be placed along drapes to make a trough. The tubings and cords will be handed off field and appropriately connected. These include a suction tubing, electrocautery cord, bipolar cord, suction-irrigator tubing and a drill cord that will be anchored to drapes to prevent falling off while patient is turned from side to side during the procedure.

The post-auricular incision will be made with a #15 knife, and electrocautery will be used for hemostasis. A small Wullstein retractor will be placed for better visualization. A wide Lempert elevator will be used to remove the temporalis muscle from the temporal bone. Metzenbaum scissors and toothed Adson forceps will be used to harvest fascial graft. The graft will then be placed on a white block and under a light for drying. The mastoid periosteal incisions will be made along the temporal line and perpendicular anteriorly along the posterior rim of the glenoid fossa down to the mastoid tip. The Lempert elevator will be used to elevate the periosteal flap, which then will be reflected posteriorly to expose the cribriform area and posterior rim of the glenoid fossa. The surgeon will drill the canal with a 5-mm cutting burr to remove the bulk of the bone. Care will need to be taken not to disturb the fascial nerve, which will be embedded in the temporal bone. A 3-mm, 2-mm, 1½-mm and 1-mm diamond burr will be used to expose the middle ear ossicles. A dental excavator will be used to gently remove bone pieces from the incus and malleus bones. A 20-gauge suction tip will be used to remove blood from the middle ear. Copious lactated ringer irrigation in a bulb syringe will be used to remove the bone dust and the soft tissue within the sterile field. The ossicles' mobility will be tested with a Rosen needle. The Jacobson nerve, incus, stapes, footplate, pedial tendon, chordae timpita, malleus, oval window and facial nerve all will be identified. If the movement is impaired, reconstruction will be performed with cartilage or prosthesis. Free space will be needed around the ossicles prior to reconstruction. The sterile field then will be covered by cloth towels during the skin harvest.

The skin will be harvested from the inner upper extrem-

The instruments will be set up like any ear case with some additional pieces. A #7 knife handle will be used with the #11 knife blade for the meatoplasty. Two smooth jewelers' forceps will be used to handle the skin graft during preparation and placement.

ity or the upper lower extremity. The surgeon will decide which location works best for each patient, and the circulator will untuck the desired arm and place it on the supported table. A ofloxacin solution will be used to prep the site. Four cloth towels will be placed around the site. The end of the dermatome cord will be handed off the field, attached to the nitrous oxide power source, turned up to 125 MHz and then the dermatome will be tested.

The new ear canal will be created, also known as meatoplasty. With a #15 blade and Adson forceps, the surgeon will establishes the outer ear canal dimensions

The surgeon will adjust the thickness of the dermatome to about 0.006 inches and test the edge of the dermatome blade with a #15 knife blade. The skin prep will be washed off with a wet sponge and a dry sponge. Mineral oil will be applied to the skin and the dermatome will be applied with a cotton ball loaded on a Crile clamp. The harvested skin graft will need to measure 5 cm by 7 cm. The graft will then be prepared on a separate Mayo stand. A skin carrier, three metal cups, two smooth forceps, a white block and an unused #15 knife on a #3 handle will be used. The dermatome then will be disconnected from the power source and dismantled. The dermatome will need to be placed on the needle magnet to prevent a team member from getting cut. The surgical technologist will dress the graft site with a xeroform gauze, non-adherent dressing and three squares of cotton gauze. The circulator will wrap the arm with a sterile cotton wrap and replace the arm under the drapes. A sterile sheet will be laid over the area and stapled down to re-establish a sterile field. If the lower extremity is preferred, it will be prepped at the same time as the ear. Utility scissors will be used to expose the leg for the split thickness skin harvest. Dressings will be applied and a medium sheet will be placed over the lower extremities.

Then, the new ear canal will be created, also known as meatoplasty. With a #15 blade and Adson forceps, the surgeon will establish the outer ear canal dimensions. With a #11 blade, the surgeon will connect the middle ear to the external ear, and the tissue will be discarded. Special attention will need to be given to establish a straight connection between the outer and middle ear for better hearing conduction. A flap of skin, referred to as the conchal flap, will be sutured with a 4-0 absorbable suture.

Next, the dried fascial graft will be trimmed to size. Dipped into the lactated ringers for only a second, the graft will be rehydrated and placed into its position. A 20-gauge suction tip and moistened Rosen needle will be used. The split thickness skin graft will be brought to the ear and positioned with a ball probe and 20-gauge suction. With smooth forceps, a silicone disc will be placed in the center of the graft to recreate the malleolus-incus angle. Four pre-cut stenting wicks are placed medially.[5] The surgeon will saturate the sponges with 2 ml of an antibiotic solution. With two smooth forceps, the surgeon will gather the skin edges together into a ball. To close the post-auricular incision, the surgical technologist will pass the 3-0 absorbable suture and Adson forceps. The suture will be interrupted by burying the knots. With smooth forceps, the surgeon will deliver the new skin graft out of new ear canal. The surgeon will then anchor the edges with 5-0 fast-absorbing tissue suture. Straight iris scissors can be used as suture scissors. The surgeon will trim the skin graft edges to size with curved iris scissors. The remaining ear sponges will be placed into canal laterally and infused with 3 ml of ofloxacin solution.

The surgeon and surgical technologist will need to work together to apply the dressing. With a moist sterile gauze, the excess prep solution will be rinsed off the patient's head and face. They will count together as the electrodes and tape will be removed. The surgical technologist will need to remember to count the electrodes with the circulator before disposing of them. The dressing will be started with antibiotic ointment on a cotton ball, crescent non-adherent dressing, folded cotton gauze, unfolded cotton gauze, fluffs, a steri-strip, three rolled gauzes and cloth towel for under the dressing.

The patient will go home the same day as surgery and will return to the surgeon's office in two weeks, when the dressings will be removed. For the first time together, the surgeon, the patient and his or her family members will experience the advantage of this procedure: hearing from the operative ear.

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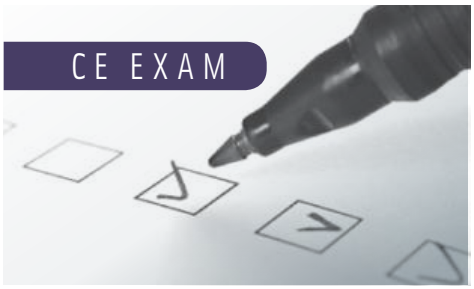

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1. In this condition, the _____ auditory ear canal is absent or closed.
a. Inner
b. External
c. Middle
d. Tiny

2. The birth defect causing this condition has how many grades?
a. 2
b. 3
c. 4
d. 5

3. Grade 3 is when the ear has skin and cartilage shaped like:
a. A peanut
b. A boot
c. A figure-eight
d. An oval

4. There are ___ critical areas of temporal bone anatomy that are given a number.
a. 6
b. 7
c. 8
d. 9

5. This procedure generally takes ___ hours.
a. 2-3
b. 4-5
c. 6-7
d. 8-10

6. With a #15 blade and ____, the surgeon will establish the outer ear canal dimensions.
a. Adson forceps
b. Crile clamp
c. #11 blade
d. Wullstein retractor

7. During meatoplasty, an opening is created in the ___ of the skin graft.
a. Inner ear
b. Outer edge
c. Outer ear
d. Center

8. After induction of general anesthesia, the operating table will be turned _____.
a. 180 degrees
b. 2 feet
c. 270 degrees
d. 1 inch

9. Depending on the patient and the surgeon's preference, the skin will be harvested from either:
a. The inner upper extremity
b. The upper lower extremity
c. Both the upper lower and inner lower extremities
d. Both the inner upper or upper lower extremities

10. _____ will trim the skin graft edges.
a. Straight iris scissors
b. #11 blade
c. Curved iris scissors
d. #15 blade

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