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AIR FORCE CENTER OF EXCELLENCE FOR MEDICAL MULTIMEDIA



About Your Ears

The ear is made of flexible, soft tissue that attaches to the side of the head. It's divided into three parts called the outer, middle and inner ear. Each part has an important function in the hearing process.

The outer ear consists of skin and cartilage, called the auricle, and the ear canal. The eardrum, or tympanic membrane, is a thin membrane that separates the outer ear from the middle ear.

The middle ear is an air-filled chamber containing three small bones called ossicles. They connect the eardrum to the inner ear and are named the malleus, (or hammer), incus, (or anvil), and stapes, (or stirrup). Normal hearing occurs when the sound waves pass through the ear canal and vibrate the eardrum.

The air chamber in the middle ear connects to the back of the nose via the Eustachian tube. In both ears, the Eustachian tube serves as a pressure-equalizing valve and drains any fluid that collects in the middle ear into the back of the throat.

The final part of the ear is called the inner ear. It contains a structure called the cochlea, which sends signals to the brain that enable hearing. The cochlea is shaped much like a snail's shell and has small hair cells, called cilia, that are bathed in fluid. These cilia send signals from the inner ear to the area of the brain that helps maintain balance when walking or sitting upright.

Eustachian Tube Issues and Ear Problems

In infants and young children, the Eustachian tubes are short and horizontal. By age seven, the Eustachian tubes are larger and more vertical, which improves their ability to function. Many problems within the middle ear space are related to the Eustachian tubes.

Normally, the Eustachian tube opens when a person swallows or yawns. Obstruction or blockage of the Eustachian tubes caused by inflammation and swelling from cold symptoms or allergies can prevent them from opening and create negative pressure. Over time, the negative pressure can pull the eardrum inward. If this happens, some fluid may be drawn into the middle ear space and cause a fluid buildup. This frequently occurs in children with upper respiratory infections or allergic symptoms.

If bacteria or a virus enters the middle ear fluid through the Eustachian tube, an ear infection called acute otitis media may develop. Symptoms include fever, ear pain, irritability, and sometimes drainage.



Anatomical, environmental, or lifestyle factors that may lead to otitis media include:

- An immature Eustachian tube
- A cleft palate
- Colds and sinus or other respiratory infections
- Allergies
- Exposure to tobacco smoke or other irritants
- Excess mucus and saliva produced during teething
- Infected or enlarged adenoids, and
- Being bottle fed in bed

The adenoids are tonsil-like tissues that are located in the back of the nose, next to the opening of the Eustachian tube.

Risk Factors for Ear Infections or Otitis Media

Ear infections, or otitis media, are most common in children, but can also occur in teens and adults. Children have a greater risk for ear infections if they are:

- In daycare
- Bottle fed
- Exposed to second- or third-hand cigarette smoke, or
- Exposed to individuals with respiratory infections

Other risk factors may include:

- Genetic factors, such as susceptibility to infection that may run in families
- Recent illness of any type that lowers the body's resistance to infection
- Toothaches or teething
- Birth defects, cleft palate, or Down syndrome, or
- Malformation of the outer ear, ear canal, or middle ear structures

An ear infection usually causes some conductive hearing loss because of the increased fluid in the middle ear, as well as eardrum thickening. As a result, the sound vibrations that travel through the middle ear are reduced. This hearing loss usually goes away once the fluid is gone.

Hearing loss is measured in decibels. A loss of 30 decibels or more may indicate a need for pressure equalization tubes, or PE tubes. Long-term hearing loss can result in speech or learning disabilities.



Symptoms of Ear Infections

For small children, the main symptoms for ear infections are irritability and inconsolable crying. If your child has an acute ear infection, they may have a fever or problems sleeping.

Other symptoms of an acute ear infection may include:

- Ear pain or earache
- Fullness in the ear
- Feeling of general illness
- Vomiting
- Diarrhea
- Hearing loss in the affected ear
- Holding, pulling, or tugging of ears
- Irritability or bouts of crying
- Drainage from the ear, or
- Changes in appetite or sleep

An ear infection may start shortly after a child has a cold or other respiratory infection. When the middle ear becomes infected, it may fill with fluid or pus. Sudden drainage of yellow or green fluid from the ear may mean a ruptured eardrum.

All acute ear infections include fluid behind the eardrum. It's important to consult with your healthcare provider to confirm any possible ear infection, if your child has symptoms.

Treatment for Ear Infections

Most viral ear infections clear up on their own without the need for antibiotics. Treating your child's discomfort and allowing their body to heal itself is often all that is needed.

You can follow these steps to help treat the pain:

- Apply a warm cloth to the affected ear
- Hold, cradle, and console the child
- Offer a pacifier
- Discuss with your healthcare provider the use of over-the-counter pain-relief drops for ears, or ask your provider to prescribe eardrops to relieve the pain. DO NOT use eardrops if your child already has drainage from their ear unless prescribed by a healthcare provider.
- Administer children's ibuprofen or pediatric acetaminophen for pain or fever. DO NOT give aspirin to your child because it could lead to other health issues.



If your child is younger than six months and has a fever or other symptoms, contact your healthcare provider immediately. If they're older than six months, have a fever higher than 102 degrees Fahrenheit, and show no improvement or symptoms get worse, call your healthcare provider to determine if medical treatment is needed.

Many healthcare providers no longer prescribe antibiotics for every ear infection in an effort to prevent resistance to antibiotics. Your child's healthcare provider is more likely to prescribe antibiotics if your child:

- Is under age two
- Has a fever
- Appears sick
- Has a respiratory infection, or
- Has not improved within 24 to 48 hours

If the antibiotic isn't working within 48 to 72 hours, contact your provider. A different antibiotic or other treatment may be needed.

If ear infections don't clear up with medical treatment, or if your child has had many ear infections over a short period of time, for example, four in six months, your healthcare provider may refer your child to an ear, nose, and throat specialist, called an ENT. The ENT specialist, or otolaryngologist, may recommend pressure equalization tubes. Although, tubes are effective in reducing chronic otitis media, ear tubes are not always a permanent cure.

What are Pressure Equalization (PE) Tubes?

Pressure equalization tubes, or PE tubes, are tiny cylinders that are surgically placed through the eardrum to allow air into the middle ear. These ear tubes may also be called tympanostomy tubes, myringotomy tubes, or ventilation tubes. These tubes help to normalize hearing and prevent recurring accumulation of fluid and infections.

PE tubes are made from various materials. They may be coated with a substance that's intended to reduce the possibility of infection.

PE tubes typically stay in place for about a year before falling out on their own. Some tubes have flanges to secure them in place for a longer period of time and then they may fall out on their own. In some cases, removal by a healthcare provider may be necessary.



Why Insert Pressure Equalization (PE) Tubes?

There are a number of reasons for your healthcare provider to suggest pressure equalization, or PE, tube placement. Your provider can discuss the specific reasons for recommending your child's PE tube surgery.

They may include:

- A substantial hearing loss in patients who have ear infections or otitis media
- Poor response to antibiotics to clear up ear infections
- Otitis media with fluid for more than three months
- Recurrent episodes of acute otitis media
- Chronic retraction of the eardrum
- Significant Eustachian tube problems during airplane flights or altitude changes
- To restore and preserve normal hearing
- Cleft palate abnormalities with hearing loss, or
- Hearing loss with associated delayed-speech or language development

Risks of PE Tube Surgery or Tympanostomy

PE tube surgery, or tympanostomy, is performed by an otolaryngologist, or ear, nose, and throat (ENT) specialist. As with most surgical procedures, there are some risks associated with PE tube surgery. Standard surgical risks may include:

- Fever
- Bleeding
- Infection, or
- Allergic or adverse reactions to anesthesia medications

Before your child's surgery, you'll have the opportunity to discuss the anesthesia risks in detail with your healthcare team. They'll be able to tell you about the types of medications that will be used, their durations, and any possible side effects. Typically PE tube surgery is brief and requires a small amount of anesthesia, which helps to keep the risks to a minimum.

For some, the procedure is not particularly painful, but if your child does experience discomfort after the tubes have been inserted, most over-the-counter pain medications can relieve any discomfort associated with the surgery. It's also important to note that some children may experience nausea and vomiting. If this occurs, offer the child small sips of clear liquids and progress to a light diet, then to a normal diet as tolerated. In any case, be sure to check with your healthcare team before offering your child any over-the-counter medication.



Complications of PE Tube Surgery

Fortunately, complications associated with the placement of pressure equalization tubes are minimal. The most common problem is recurrent or persistent drainage from the ear. The fluid that drains from the ear may be clear or appear cloudy. A relatively small percentage of children experience this type of persistent drainage. Often drainage occurs if the tubes are inserted right after the child experiences an upper respiratory infection or seasonal allergies. Fluid trapped behind an intact eardrum is now free to drain out of the ear, and the PE tubes are doing their job!

The following complications are also possible, but relatively rare:

- A PE tube may stay in longer than desired. Most tubes fall out within two years. In some children, the tubes don't fall out of the eardrum within the expected time frame and may require removal at a future date. On the other hand, a tube may also fall out prematurely and need to be replaced.
- Some swollen tissue may develop around the edges of the tube. This may lead to infection, bleeding, or drainage from the ear. The PE tube may need to be removed if the tissue doesn't heal with treatment.
- The eardrum may become thin and retract into the middle ear space. This may occur even if the PE tube functions properly.
- A hole may remain in the eardrum after the PE tube falls out. Usually the hole will heal spontaneously. If not, additional surgical treatment may be required.
- Scarring or calcification of the eardrum can occur. This is called myringosclerosis and normally does not affect your child's hearing.
- Skin from the outside of the eardrum can get into the middle ear space, causing debris to develop from dead skin cells. This is known as cholesteatoma. The dead skin can be trapped within the middle ear. If this occurs, additional surgery may be necessary.

It's extremely rare to develop permanent hearing loss after the placement of PE tubes, but the condition may occur. Keep in mind, if you have any questions or concerns about PE tube surgical complications, feel free to discuss them with your child's ENT specialist and healthcare team.

Pre-Procedure Hygiene Instructions

Bathing your child prior to surgery is a good idea. Remember to avoid using lotions, powders, or creams on your child's skin until after the surgery is over.



Routine Medications

If your child takes any medications or supplements on a regular basis, be sure to let your healthcare team know before the PE tube surgery. It's a good idea to write down the names of all the medications and supplements. List the exact name, dosage, and number of times a day each medication and supplement is taken. On the day of the procedure, take the list with you to the medical facility.

Ask your healthcare provider if your child should take any medications or supplements on the evening before the procedure or on the day of the procedure.

Anti-Inflammatory Medications

Unless your healthcare provider instructs you to administer anti-inflammatory medications to your child, it's a good idea to avoid them for two weeks prior to surgical procedures or tests. Anti-inflammatory medications, such as ibuprofen or naproxen, can cause a slight increase in bleeding. If you're not sure if a particular medication contains an anti-inflammatory, be sure to ask your child's provider.

Some supplements can also increase the risk of bleeding and should be avoided before surgery. It's recommended that you discuss all of your child's medications with your provider prior to surgery.

Foods and Fluids Before the Procedure

It's important that you ask your healthcare team when your child should have their last meal and fluids prior to their surgery.

Pre-Procedure Information

Once your healthcare provider has diagnosed the problem and recommended pressure equalization, or PE, tubes, a preoperative evaluation is usually done. The purpose of the evaluation is to learn more about your child and any special needs they may have.

Your provider will need to know about:

- Medications that are currently being used, which include supplements and over-the-counter and prescription medications, and
- Previous or potential reactions to medications, local anesthetic, latex, tape, or skin cleanser

During the evaluation, you'll also be given detailed information about the actual procedure and what to



expect. If your child is taking any medications, be sure to ask if they should be taken on the day of the procedure. Any other questions or concerns can be answered by your provider at the time of the evaluation.

Be sure to contact your provider if your child experiences an acute illness or injury, or has an asthma attack within three days prior to the scheduled surgery. Also if your child is exposed to measles, mumps or chicken pox within 21 days prior to the procedure, be sure to alert your provider. In some cases, the surgery may need to be rescheduled.

Medical Facility Check In

When your child arrives at the medical facility for the PE tube surgery, it's likely you'll need to complete some paperwork. Remember to bring personal and/or military identification and health insurance documents.

You may be able to complete some of the pre-admission paperwork over the phone or online, prior to the date of the procedure. Check with the medical treatment facility to see if this is the case. If so, this can help to speed up the admission process on the day of the surgery.

You may need to provide additional medical records, lab results, or X- rays. Check with your healthcare provider to see if these or any other items are needed. Parents or legal guardians must sign for the admission of those under the age of 18.

What to Take and Wear to the Medical Facility

Before the surgery, it's important to prepare your child for the procedure and possible hospital stay. Obtaining a general understanding of the medical facility and procedures can help the entire family feel more comfortable with any potential hospitalization. It's a good idea to visit the medical facility ahead of time, if that's possible.

Before the procedure pack a small bag of personal items, such as:

- A favorite toy, stuffed animal, or blanket
- A pacifier
- Pajamas, socks, and extra underwear
- Robe and slippers
- A pillow
- Favorite music
- Toothbrush and toothpaste
- Glasses, and
- Books



Parents and caregivers should be sure to take the following items, as well:

- Any medications your child is currently taking
- A list of known allergies to foods, medications, or other substances
- Personal and/or military identification
- Health insurance documents, and
- Reading materials

Clothes worn to the medical facility should be loose, comfortable, and casual. It's a good idea for parents and caregivers to leave valuables, such as jewelry or large amounts of cash, at home.

What To Tell the Provider and Medical Facility

During your child's pre-procedure evaluation and during the medical facility check in, share the following patient information:

- Previous reactions or allergies to any medications, local anesthesia, tape, latex, or skin cleanser
- Special needs, such as religious or dietary preferences, or physical assistance requirements, and
- Medications that are currently being used, which include supplements and over-the-counter and prescription medications

Pressure Equalization (PE) Tube Procedure

For PE tube placement, young children are usually given a general anesthetic in an outpatient surgical setting. Insertion of a breathing tube is generally not required.

After the patient is under a comfortable level of anesthesia, the eardrum is viewed using a special microscope. Any wax that obstructs the view of the eardrum is carefully removed and the eardrum is thoroughly inspected.

A small incision is then made in the front portion of the eardrum — to avoid injury to the ossicles, the three small bones in the middle ear. The incision is called a myringotomy. A small suction device is used to remove any fluid that has collected in the middle ear space. Keep in mind, if infected fluid is found, your child may require antibiotic treatment after surgery.

Once the fluid has been removed from the middle ear space, a PE tube is carefully placed through the incision, using small instruments.

There are many types of PE tubes. The tubes can be made out of various materials and may have a coating on



them intended to reduce the possibility of infection. Two major types of tubes include:

- Short, grommet-shaped tubes, and
- Long, T-shaped tubes

Grommet-shaped tubes are used most often in pediatric procedures, especially if it's the first set of PE tubes inserted in the child's ears. Grommet-shaped tubes generally remain in place for 12 months. T-shaped tubes may remain in place for several years.

If your child is receiving a second or third set of PE tubes, your healthcare team may recommend removal of the adenoids at the same time. Discuss this option with your healthcare provider, prior to the procedure. After the PE tubes have been properly positioned in the eardrum and the procedure is complete, the patient is awakened by the anesthetist and transported to the recovery room. Your child will be carefully monitored by the healthcare team during recovery.

Post-Procedure Care

Once surgery is completed, your child will be taken to the recovery room.

Depending on the medical facility, parents or caregivers may be allowed in the recovery room. The healthcare team monitors your child while the anesthesia wears off. If no complications occur, your child is usually released from the medical facility on the same day.

Your provider may prescribe eardrops and/or oral antibiotics for a few days after surgery. It's always important to follow your healthcare provider's post-op and home-care instructions.

Specific instructions may also be given regarding:

- Physical activities and diet
- Drainage, fever, infection, bleeding, or excessive pain
- When the child can return to daycare or school
- Water activity instructions, and
- How to keep the ear canal dry

To avoid the possibility of bacteria entering the middle ear, your healthcare team may recommend keeping your child's ears dry by using ear plugs or other water-tight devices during bathing, swimming, and other water activities. In most cases, special protection may not be necessary.

For children who are allowed to get their ears wet while swimming in a pool, it's important not to dive too far below the surface of the water. The pressure from this may cause water to enter the middle ear.



Your child will need a follow-up visit with their healthcare team shortly after the surgery. Your provider will check the PE tubes to make sure they're still in place and that the eardrums are healing properly.

The majority of children do well after PE tube surgery. Most resume their normal routines within a few days.

It's important to keep in mind that your child can still develop ear infections, even with PE tubes in place. If an infection occurs after surgery, it may be caused by:

- Fluid not draining from the ear
- Re-exposure to bacteria or a virus, or
- Irritation to the ear

Typically, as long as the PE tubes are functioning properly, any infection should be less severe and less frequent. However, if your child has any drainage, fever, or other symptoms, be sure to inform your healthcare team. Antibiotic eardrops may be needed.

After the PE tube surgery, feel free to contact your healthcare provider if you have any questions or concerns.

Prescription Medications After Surgery

Your child may need medication after surgery, which your provider will prescribe. In some medical or clinical facilities, the provider's order for the medication can be filled by its pharmacy. In other cases, your provider may give you the written prescription or call in the prescription to the pharmacy of your choice.

When medications are required for your child, it's always important to follow your provider's instructions. If you have any questions about possible side effects or unusual drug interactions, it's a good idea to talk with the pharmacist or contact your child's provider.

Transportation From the Medical Facility

After your child's surgical procedure, it's sometimes recommended that two adults be available for the trip home — one to drive and one to care for the child.

Some children may experience post-operative discomfort, irritability, or nausea and vomiting during the ride home. Having two caregivers allows one parent to care for the child.



After Your Child is Home

Once your child is home from the PE tube surgery, helpful tips include:

- Check on them every few hours for two or three days
- If your child cannot be consoled because of discomfort, or if you believe the medications aren't working properly, or a rash or allergic reaction develops, contact your healthcare provider immediately. The medications may need to be changed or discontinued.
- Never give your child old, expired medications or someone else's medication, and
- Always properly dispose of unused prescription medications promptly. Most military medical treatment facilities have drop-off boxes to properly dispose of old or expired prescription medications. If you have questions, contact your medical treatment facility.

Military Considerations

There are unique medical requirements for U.S. military families. Parents should obtain or have the following:

- Referral and approval for the surgical procedure
- Current military ID and TRICARE insurance card
- Copies of any other health insurance or third-party billing information
- Discussion about the surgery with your child's on- and/or off-base childcare provider
- Information about other on-base resources to assist the military parent or caregivers
- Discussion about the surgery and hospital stay with the military parent's supervisor
- Support and assistance for homecare, and
- Discussion with the military parent's supervisor regarding time off to care for the child

Information or Questions About this Program

If you have questions about this program or the Center of Excellence for Medical Multimedia (CEMM), please visit our Web site at www.cemmlibrary.org.



Tips

EAR INFECTION TIP

If your child has an ear infection, try applying a warm cloth to the affected ear to help relieve the pain. Children's ibuprofen or pediatric acetaminophen can also help reduce pain and fever.

PE TUBES TIP

If your child doesn't respond to antibiotics to clear up ear infections or experiences persistent otitis media, your healthcare provider may recommend PE Tube surgery.

PRE-PROCEDURE TIP

Remember to bring any medications your child is taking, a list of known allergies, personal and/or military identification, and health insurance documents when you check in for your child's PE Tube surgery.

PRE-PROCEDURE TIP

Be sure to bring personal items that will make your child more comfortable at the hospital, such as your child's favorite toy or stuffed animal, their own pillow, or their favorite music.

POST-PROCEDURE TIP

It's a good idea to have two adults available for the ride home from the hospital — one to drive and one to care for the child.

MEDICATION TIP

If your child is experiencing pain or fever, DO NOT give them aspirin because it could lead to other health issues. If your child is not responding to medication, call your healthcare provider.