

Plumbing and Air for Emergency Physicians:

Foreign Bodies in the Ear, Nose, and Throat in Children



EM Rooters

"We'll get out what your kid put in!"



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Anyplace, USA

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Children the world over are fascinated with what can possibly “fit” in their orifices. Diagnosis is often delayed. Anxiety abounds before and during evaluation and management.

Most common objects:^{1,2}

Food	Coins	Toys
Insects	Balls, marbles	Balloons
Magnets	Crayon	Hair accessories, bows
Beads	Pebbles	Erasers
Pen/marker caps	Button batteries	Plastic bags, packaging

Non-pharmacologic techniques

Set the scene and control the environment. Limit the number of people in the room, the noise level, and minimize “cross-talk”. The focus should be on engaging, calming, and distracting the child.

Quiet room; calm parent; “burrito wrap”; guided imagery; have a willing parent restrain the child in his or her lap – an assistant can further restrain the head.

Procedural Sedation

Most foreign bodies in the ear, nose, and throat in children can be managed with non-pharmacologic techniques, topical aids, gentle patient protective restraint, and a quick hand. Consider sedation in children with special health care needs who may not be able to cooperate and technically delicate extractions. **Ketamine** is an excellent agent, as airway reflexes are maintained.³ Remember to plan, think ahead: where could the foreign body be displaced if something goes wrong? You may have taken away his protective gag reflex with sedation. Position the child accordingly to prevent precipitous foreign body aspiration or occlusion.

L'OREILLE – DAS OHR – ухо – **THE EAR** – LA OREJA – 耳 – L'ORECCHIO

Essential anatomy:

The external auditory canal. Foreign bodies may become lodged in the narrowing at the bony cartilaginous junction.⁴ The lateral 1/3 of the canal is flexible, while the medial 2/3 is fixed in the temporal bone – here is where many foreign bodies are lodged and/or where the clinician may find evidence of trauma.

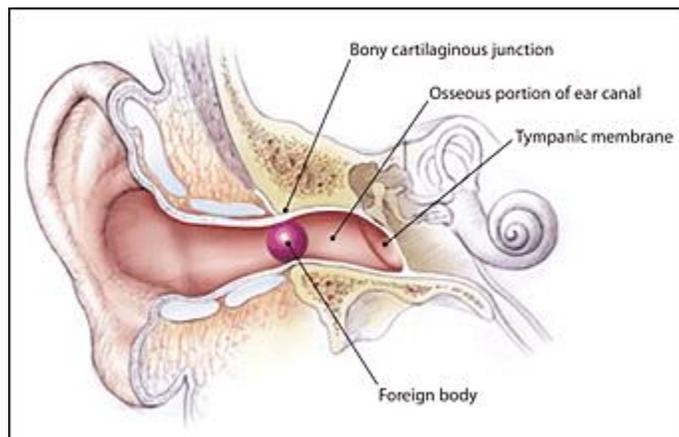


Image courtesy Christy Krames

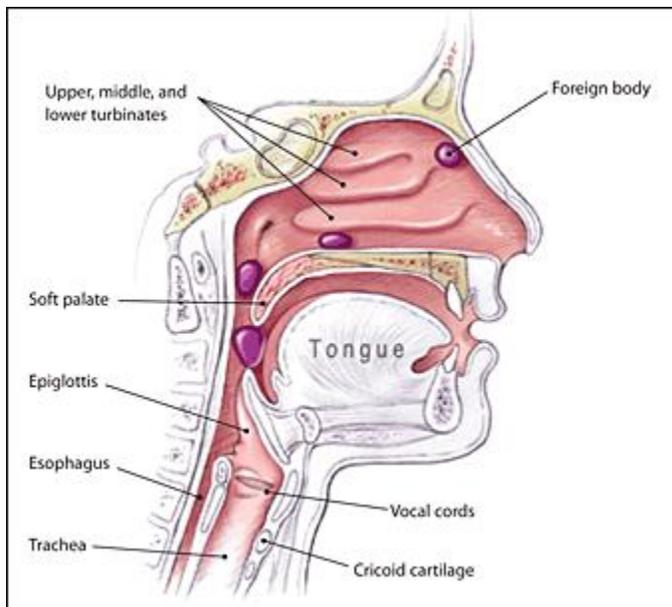
Pearls:

- Ask yourself: is it graspable or non-graspable?⁵
 - Graspable: 64% success rate, 14% complication rate
 - Non-graspable: 45% success rate, 70% complication rate⁵
- If there is an **insect** in the external auditory canal, **kill it first**. *They will fight for their lives* if you try to dismember or take them out. “In the heat of battle, the patient can become terrorized by the noise and pain and the instrument that you are using is likely to damage the ear canal.”^{5,6} Use lidocaine jelly (preferred), viscous lidocaine (2%), lidocaine solution (2 or 4%), isopropyl alcohol, or mineral oil.
- Vegetable matter? Don't irrigate it – the organic material will swell against the fixed structure, and cause more pain, make it much harder to extract, and may increase the risk of infection.

Pifalls:

- Failure to inspect after removal – is there something else in there?
- Failure to assess for abrasions, trauma, infection – if any break in skin, give prophylactic antibiotic ear drops
- Law of diminishing returns: probability of successful removal of ear foreign bodies declines dramatically after the first attempt

 LE NEZ – DIE NASE – нос – **THE NOSE** – LA NARIZ – 鼻 – IL NASO



Essential anatomy:

Nasopharyngeal and tracheal anatomy. Highlighted areas indicate points at which nasal foreign bodies may become lodged.⁴

Image courtesy Christy Krames

Pearls:

- Consider using **topical analgesics** and **vasoconstrictors** to reduce pain and swelling – and improve tolerance of/cooperation with the procedure. Use 0.5% **oxymetolazone** (Afrin) spray and a few drops of 2 or 4% **lidocaine**. Pros: as above. Cons: possible posterior displacement of the foreign body.⁷
- **Be ready** for the precipitous development of an **airway** foreign body

Pitfalls:

- Beware of **unilateral nasal discharge** in a child – strongly consider retained foreign body.⁸
- Do not push a foreign body down the back of a patient's throat, where it may be aspirated into the trachea.
- Be sure to **inspect the palate** for “vacuum effect”: small or flexible objects may be found on the roof of the mouth, just waiting to be aspirated.

LA GORGE – DER HALS – горло – **THE THROAT** – LA GARGANTA – 喉 – LA GOLA

Before we go further –

Remember that a **foreign body in the mouth or throat can precipitously become a foreign body in the airway**. Foreign body inhalation is the most common cause of accidental death in children less than one year of age.^{9,10}

Go to BLS maneuvers if the child decompensates.

Infants under 1 year of age – back blows: head-down, 5 back-blows (between scapulae), 5 chest-thrusts (sternum). Reassess, repeat as needed.

Children 1 year and up, conscious – Heimlich maneuver: stand behind patient with arms positioned under the patient's axilla and encircling the chest. The thumb side of one fist should be placed on the abdomen below the xiphoid process. The other hand should be placed over the fist, and 5 upward-inward thrusts should be performed. This maneuver should be repeated if the airway remains obstructed. Alternatively, if patient is supine, open the airway, and if the object is readily visible, remove it. Abdominal thrusts: place the heel of one hand below the xiphoid, interlace fingers, and use sharp, forceful thrusts to dislodge. Be ready to perform CPR.

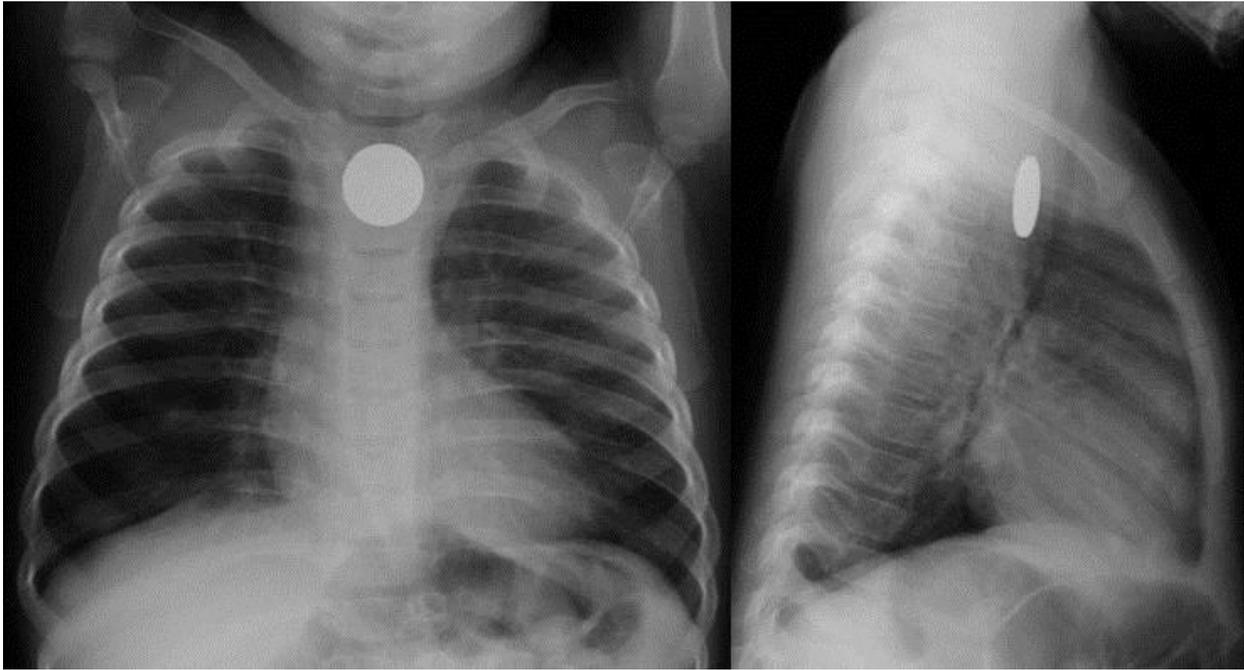
Children 1 year and up, unconscious – CPR: start CPR with chest compressions (do not perform a pulse check). After 30 chest compressions, open the airway. If you see a foreign body, remove it but do not perform blind finger sweeps because they may push obstructing objects further into the pharynx and may damage the oropharynx. Attempt to give 2 breaths and continue with cycles of chest compressions and ventilations until the object is expelled.

Chest films are limited: **80% of airway foreign bodies are radiolucent.**¹¹ Look for unilateral hyperinflation on expiratory films: air trapping.

Alright, now on to our show –

Essential anatomy:

Most esophageal foreign bodies in children occur **at the level of the thoracic inlet / cricopharyngeus** muscle (upper esophageal sphincter). Other anatomically narrow sites include the level of the aortic arch and the lower esophageal sphincter.



Coin *en face* – in the esophagus – lodged at the thoracic inlet.¹² The pliable esophagus accommodates the flat coin against the flat aspect of the vertebra.¹¹

Beware the “**double-ring**” sign: this is a button battery¹³

This is an emergency: the electrolyte-rich mucosa conducts a focal current from the narrow negative terminal of the battery, rapidly causing burn, necrosis, and possibly perforation. Emergent removal is required.

Button batteries that have passed into the stomach do not require emergent intervention – they can be followed closely.



Not a button battery, not a sharp object, not a long object?

If there is no obstruction, consider reevaluation the next day – may wait up to 24 hours for passage.¹⁴ Sharieff et al.¹⁵ found that **coins found in the mid to distal esophagus within 24 hours all passed successfully.**

What conditions prompt urgent removal?

Size

Infants: objects smaller than **2 cm wide and 3 cm long** will likely pass the pylorus and ileocecal valve¹⁰

Children and adults: objects smaller than **2 cm wide and 5 cm long** will likely pass the pylorus and ileocecal valve⁹

Character

Sharp objects have a high rate of perforation (35%)¹⁴

Pearls:

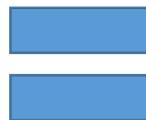
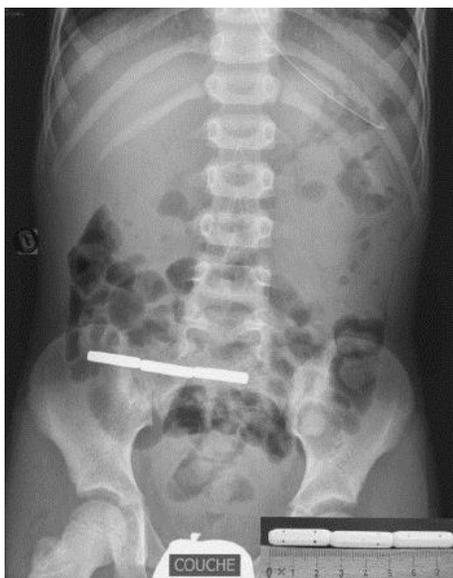
- History is essential. Believe the parents and assume there is an aspirated/ingested foreign body until proven otherwise.
- History of choking, has **persistent symptoms and/or abnormal xray?** *Bronchoscopy!* Cohen et al.¹⁶ found that of 142 patients evaluated at a single site university hospital, 61 had a foreign body. Of the 61 patients, 42 had abnormal physical exams and radiographs and 17 had either abnormal physical exams or radiographs, and 2 had normal physical exams and radiographs, but both had a history of persistent cough.

Bottom line: **history of choking PLUS abnormal exam, abnormal films, or persistent symptoms, evaluate with bronchoscopy.**

- For patients with some residual suspicion of an aspirated foreign body (mild initial or improving symptoms; possibly abnormal chest x-ray; low but finite risk), consider chest CT with virtual bronchoscopy as a rule-out strategy.^{17,18}
- Outpatients who have passed a small and non-concerning object into the stomach or beyond: serial exams and observing stools – polyethylene glycol 3350 (MiraLAX) may be given for delayed passage¹⁹

Pitfalls:

- A single household magnet will likely pass through the GI tract, with the aforementioned dimensional caveats. Two or more magnets, however, run the risk of attraction and trans-bowel wall pressure necrosis.
- Not all magnets are created equal. Neodymium magnet toys (“buckyballs”) were recalled in 2014 (but are still out there!) due to their highly attractive nature. These magnets must be removed to avoid bowel wall ischemia.^{19–21}
- Patients should avoid wearing belt buckles or metallic buttons in case of single magnet ingestion while waiting for the single magnet to pass



Raquillet C et al. Avaler des aimants : un jeu dangereux. À propos d'une observation. *Archives de Pédiatrie*. 2008; 15(6):1095-1098.

DES OUTILS DU MÉTIER – DIE HANDWERKSZEUG – Знаряддя праці
– **TOOLS OF THE TRADE** –
LAS HERRAMIENTAS DEL OFICIO – GLI ATTREZZI DEL MESTIERE – 仕事のツール

It's best to keep your armamentarium as large as you can.

Curette

A small foreign body in the **lateral 1/3 of the auditory canal** may be amenable to a simple curettage. Hair beads (if the central hole is accessible) may be manipulated out with the angled tip of a rigid curette. Steady the operating hand by placing your hypothenar eminence on the child's zygoma or temporal scalp, to avoid jutting the instrument into the ear canal with sudden movement. There is a large selection of disposable simple and lighted curettes on the market.

Right-angle Hook

Various eponymous hooks are available for this purpose; one in popular use is the **Day hook**, which may be passed behind the foreign body.²² An inexpensive and convenient alternative to the commercially available right-hooks is a **home-made version**: make your own by straightening out a paperclip and bending it to a right angle²³ at 2-3 mm from the end (be sure not to use the type that have a friable shiny metallic finish, as the residue may be left behind in the ear canal). If it is completely lodged, use of a right-angle hook will likely only cause trauma to the canal.

Alligator forceps

Alligator forceps are best **for grasping soft objects like cotton or paper**. Smooth, round or oval objects are not amenable to extraction with alligator forceps. When using them, be sure to get a firm, central grip on the object, to avoid tearing it into smaller, less manageable pieces.

Pro tip: Look before you grip! Be careful to visualize the area you are gripping, to avoid pulling on (and subsequently avulsing) soft tissue in the ear canal.

Cyanoacrylate (Dermabond®, SurgiSeal®)

Apply cyanoacrylate to either side of a long wooden cotton swab (the lecturer prefers the cotton tip side, for improved grip/molding around object). Immediately apply the treated side to the object in the ear canal in a restrained patient. Steady the hypothenar eminence on the child's face to avoid dislodgement of the cotton swab with sudden movement. **Apply** the treated swab to the foreign body **for 30-60 seconds**, to allow bonding. Slowly pull out the foreign body. Re-visualize the ear canal for other retained foreign bodies and abrasion or ear canal trauma.

Did the cyanoacrylate drip? Did the swab stick to the ear canal?

No problem – use 3% **hydrogen peroxide** or **acetone**.²⁴ Pour in a sufficient amount, allow to work for 10 minutes. Both agents help to dissolve ear wax, the compound, or both. Repeat if needed to debond the cyanoacrylate from the ear canal.^{24,25}

Irrigation

Irrigation is the default for non-organic foreign bodies that are not amenable to other extraction techniques. Sometimes the object is encased in cerumen, and the only “instrument” that will fit behind the foreign body is the slowly growing trickle of water that builds enough pressure to

expulse it. **Do not use if there is any organic material involved:** the object will swell, causing much more pain, difficulty in extraction, and possibly setting up conditions for infection.

Position the child either prone or supine, gently restrain (as above). **Let gravity work for you:** *don't irrigate in decubitus position with the affected ear up.* It may be more accessible to you, but you may never get the foreign body out.

To use a butterfly needle: use a small gage (22 or 24 g) butterfly set up, cut off the needle, connect the tubing to a 30 mL syringe filled with warm or room-temperature water. Insert the free end of the tubing gently, and “secure” the tubing with your pinched fingers while irrigating (think of holding an ETT in place just after intubation and before taping/securing the tube). Gently and slowly increase the pressure you exert as you irrigate.

To use an IV or angiocatheter: use a moderate size (18 or 20 g) IV, remove the needle and attach the plastic catheter to a 20 mL syringe, and irrigate as above.

Acetone

Acetone has been used successfully to remove **chewing gum, Styrofoam, and superglue** from the ear canal^{24,26,27} Use in cases where there is no suspicion of perforation of the tympanic membrane.

Docusate Sodium (Colace®)

Cerumen is composed of sebaceous and ceruminous secretions and desquamated skin. Genetic, environmental, and anatomical factors combine to trap a foreign body in the external canal. Use of a ceruminolytic such as docusate sodium may help to loosen and liberate the foreign body.²⁸ *Caveat medicus:* Adding docusate sodium will make the object more slippery – this may or may not be an issue given the nature of the foreign body.

In the case where loosening the ear wax may aid extraction (and will not cause a slippery mess), consider filling the ear canal with docusate sodium (Colace), having the child lie with the affected side up, waiting 15 minutes, and proceeding. This is especially helpful when planning for irrigation.

Magnets

Rare earth magnets (a misnomer, as their components are actually abundant) such as **neodymium** can be useful in retrieving metallic foreign bodies (e.g. button batteries in the nose or ears).^{29,30} Magnetic “**pick-up tools**” – used by mechanics, engineers, and do-it-yourselfers – are inexpensive and readily available in various sizes, shapes, and styles such as a telescoping extender. Look for a small tip diameter (to fit in the ear canal as well as the nose) and a strong “hold” (at least a 3-lb hold).

Alternatively, you may purchase a **strong neodymium bar magnet** (30- to 50-lb hold) to attach to an instrument such as an alligator forceps, pick-up forceps, or small hemostat (a pacemaker magnet may also work). The magnetic bar, placed in your palm at the base of the instrument, will conduct the charge (depending on the instrument) and allow you to retrieve many metallic objects.³¹ Although

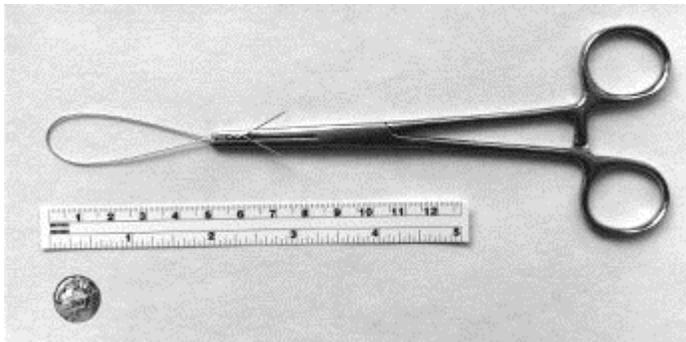


stainless steel is often said to be “non-magnetic”, it depends on the alloy used, and some may actually respond to the strong rare earth magnet. Most stainless steel has a minimum of 10.5% chromium, which gives the steel its 'stainless' properties (essentially corrosion resistance). A basic stainless steel has a “ferritic” structure and is magnetic. Higher-end stainless steel such as in kitchen cutlery have an “austenitic” structure, with more chromium added, and so less magnetic quality. (Ironically, the more “economical” instruments in the typical ED suture kit have less chromium, and so are more magnetic – use these with your neodymium bar magnet to conduct the magnetic charge and extract the metallic foreign body.)

Bottom line: if it's metal, it's worth a try to use a magnet. Even if the metal is very weakly magnetic, the strong neodymium magnet may still be able to exert a pull on it and aid in extraction.

Snare Technique

A relatively new method, described by Fundakowski et al.³² consists of using a small length of 24-gauge (or similar) wire (available inexpensively online, and kept in your personal “toolkit”; see Appendix B below) to make a loop that is secured by a hemostat (the 24-gauge wire is easily cut into strips with standard trauma scissors). After treatment with oxymetolazone (0.05%) and lidocaine (1 or 2%) topically, the loop is passed behind the foreign body (in the



case report, a button battery). Pull the loop toward you until you feel that it is sitting up against the button battery. Now, turn the hemostat 90° to improve your purchase on the foreign body. Pull gently out. This technique is especially useful when the foreign body has created marked edema, either creating a vacuum effect or making it difficult for other instruments to pass.

Balloon Catheters (Katz extractor®, Fogarty embolectomy catheter)

Small-caliber devices (5, 6, or 8 F) originally designed for use with intravascular or bladder catheterization may be used to extract foreign bodies from the ear or nose.^{7,33} A catheter designed specifically for foreign body use is the **Katz extractor**. Inspect the ear or nose for potential trauma and to anticipate bleeding after manipulation (especially the nose). Deflate the catheter and apply surgical lubricant or 2% lidocaine jelly. Insert the deflated catheter and gently pass the device past the foreign body. Inflate the balloon and slowly pull the balloon and foreign body out. Re-inspect after extraction.



NB, from the manufacturer of the Katz extractor, InHealth: “the Katz Extractor oto-rhino foreign body remover is intended principally for extraction of impacted foreign bodies in the nasal passages. This device may also be used in the external ear canal, based upon clinical judgment.”

Mother's kiss

The mother's kiss was first described in 1965 by Vladimir Ctibor, a general practitioner from New Jersey.³⁴ "The mother, or other trusted adult, places her mouth over the child's open mouth, forming a firm seal as if about to perform mouth-to-mouth resuscitation. While occluding the unaffected nostril with a finger, the adult then blows until feeling resistance caused by closure of the child's glottis, at which point the adult gives a sharp exhalation to deliver a short puff of air into the child's mouth. This puff of air passes through the nasopharynx, out through the non-occluded nostril and, if successful, results in the expulsion of the foreign body. The procedure is fully explained to the adult before starting, and the child is told that the parent will give him or her a "big kiss" so that minimal distress is caused to the child. The procedure can be repeated a number of times if not initially successful."³⁴



Positive Pressure Ventilation with Bag Valve Mask



This technique is an approximation of the above mother's kiss technique – useful for unwilling parents or unsuccessful tries.^{10,25} The author prefers to position the child sitting up. A self-inflating bag-mask device is fitted with **a very small mask**: use an abnormally small mask (otherwise inappropriately small for usual resuscitative bag-mask ventilation) **to fit over the mouth only**. Choose an infant

mask that will cover the child's mouth only. Occlude the opposite nostril with your finger while you form a tight seal with the mask around the mouth. Deliver short, abrupt bursts of ventilation through the mouth – be sure to maintain good seals with the mask and with your finger to the child's nostril – until the foreign body is expelled through the affected nostril.

Beamsley Blaster (Continuous Positive Pressure) Technique

For the very uncooperative child with a nasal foreign body amenable to positive pressure ventilation who fails the mother's kiss and bag-mask technique, a continuous positive pressure method may be used. Connect one end of **suction tubing** to the male adaptor ("Christmas tree") of an **air or oxygen source**. Connect the other end of the suction tubing to a male-to-male adaptor (commonly used for chest tube connections or connecting / extending suction tubes). Insert the



end of the device into the child's unaffected nostril. The air flow will deliver positive pressure ventilation continuously.

With this technique there is a theoretical risk of barotrauma to the lungs or tympanic membranes. However, there is only one case reported in the literature of periorbital subcutaneous emphysema.



Image courtesy of Mara Aloï, MD

To minimize this risk, some authors recommend limiting to a maximum of four attempts using any positive pressure method.¹⁰

Nasal speculum

Optimize your visualization with a nasal speculum. The nostrils, luckily, will accommodate a fair amount of distention without damage.



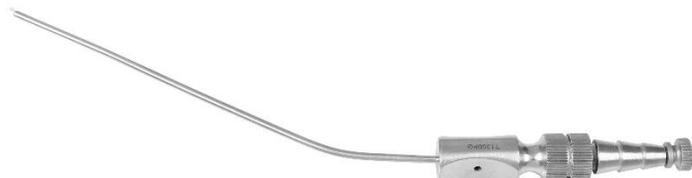
Hold the speculum vertically to avoid pressure on and damage to the vessel-and-nerve-rich nasal septum. Hold the handle of the speculum in the palm of your hand comfortably and **while placing your index finger on the patient's ala**. This will help to control the speculum and your angle of sight. Your other hand is then free to use a hook or other tool for extraction.

Lighting is especially important when using the nasal speculum: a focused procedure light or head lamp is very helpful. The author keeps a common camping LED headlamp in his bag for easy access.

AO Foundation, Davos, Switzerland

Suction tips / catheters

Various commercial and non-commercial suction devices are on the market for removal of foreign bodies. All connect to wall suction, and vary by style, caliber of suction, and tip end interface. A commonly available suction catheter is the **Frazier suction tip** (*right*), a single-use device used in the operating room.





A modification to suction can be made with the **Schuknecht foreign body remover** (*left*; not to be confused with the suction catheter of the same name): a plastic cone-shaped tip placed on the end of the suction catheter to increase vacuum surface area and seal.

Laryngoscope and Magill Forceps

If a child aspirates and occludes his airway, return to BLS maneuvers (as above). If the child becomes obtunded, use direct laryngoscopy to visualize the foreign body and remove with the Magill forceps. Hold the laryngoscope in your left hand as per usual. Hold the Magill forceps in your right hand – **palm side down** – to grasp and remove the foreign body.



Image courtesy of Kristian La Greca, EMT-P

Lecture Take-home Points

1. Beware the “**vacuum palate**”: a flat (especially clear plastic) foreign body hiding on the palate
2. Take seriously the complaint of **foreign body without obvious evidence** on initial inspection – **believe** that something is in there until proven otherwise
3. Control the environment, address analgesia and anxiolysis, **have a back-up plan**

Motto

Like a difficult airway: plan through the steps

MERCI – DANKE – Дякую – **THANK YOU** – GRACIAS – ありがとう – GRAZIE

Appendix A: Prevention

At the end of the visit, after some rapport has been established, counsel the caregivers about age-appropriate foods and “child-proofing” the home. This is a teachable moment – and only you can have this golden opportunity!

Age-appropriate foods

0-6 months: breastmilk or formula

6-9 months: introduce solid puree-consistency foods

9-12 months: small minced solids that require no chewing (well cooked, soft, chopped foods)

Although molars (required for chewing) erupt around 18 months, toddlers need to develop coordination, awareness to eat hard foods that require considerable chewing.

Not until 4 years of age (anything that *requires* chewing to swallow):

- Hot dogs
- Nuts and seeds
- Chunks of meat or cheese
- Whole grapes
- Hard or sticky candy
- Popcorn
- Chunks of peanut butter
- Chunks of raw vegetables
- Chewing gum

Child-proofing the home

Refer parents to the helpful multi-lingual site from the American Academy of Pediatrics:

<http://www.healthychildren.org/English/safety-prevention/at-home/Pages/Childproofing-Your-Home.aspx>

An abbreviated list: use age-appropriate toys and “test” them out before giving them to your child to verify that there are no small, missing, or loose parts. Secure medications, lock up cabinets (especially with chemicals), do not store chemicals in food containers, secure the toilet bowl, and unplug appliances.

Parents should understand that “watching” their child alone cannot prevent foreign body aspiration: a recent review found that in 84.2% of cases, incidents resulting in an airway foreign body occurred in the presence of an adult.³⁵

Best overall tip: get down on all fours and inspect your living area from the child’s perspective. It is amazing what you will find when you are least expecting it.

Appendix B: The Lecturer's ENT Foreign Body Toolkit

Although your institution should supply you with what you need to deal with routine problems, we all struggle with having just what we need when we need it. High-volume disposable items such as cyanoacrylate (Dermabond), curettes, supplies for irrigation, alligator forceps, and the like certainly should be supplied by the institution. However, some things come in very handy as our back-up tools.

NB: we should be cognizant of the fact that tools that must be sterilized or autoclaved are not good candidates for our personal re-usable toolkits.

These items can all be found inexpensively – shop around online, or in home improvement stores:

- Head lamp, LED camping style: \$5-15
- Neodymium magnet “pick-up tool”: \$5-15
- Neodymium bar magnet: \$6-20
- Wire, 24-gauge, spool of 25 yards (for snare technique): \$6
- Day hook: \$15-20

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