

PEDIATRIC EMERGENCY MEDICINE PRACTICE

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An Evidence-Based Review Of Pediatric Retained Foreign Bodies

A 4-year-old girl is brought to the emergency department (ED) one night by her parents, who report unilateral foul-smelling nasal drainage for 4 weeks. The girl finally admitted to her mother that she put a wooden bead into her nose, and it had become painful. The parents attempted to remove the bead but were unsuccessful, and the child is now resistant to further attempts. You contemplate the equipment and personnel at your disposal on this busy Saturday night. Will moderate sedation be needed for something as seemingly insignificant as removal of a nasal foreign body? Should you inconvenience your ENT colleagues for a consult?

As you imagine the wrestling match you are about to have with your first patient, you pick up the next chart, which lists a chief complaint of "vaginal itching." This sounds like an easy encounter until you realize that the patient is another 4-year-old child. How do you perform an adequate vaginal examination on a child without causing her significant discomfort or emotional distress? More importantly, what causes vaginal itching in a 4-year-old?

Later in your shift, a 2-year-old boy is brought in. The mother reports that the child put a quarter in his mouth earlier that evening, and she insists that he swallowed it. No vomiting or choking was witnessed. The child appears comfortable and is in no obvious respiratory distress. On examination the oropharynx is clear, and the lungs sound clear. Still, the mother insists the child swallowed the coin. A chest x-ray does show a circular image overlying the mediastinum on an anterior-posterior (AP) film. How should this situation be managed? Are consultants required? Is a period of observation warranted?

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Authors

Brian Rempe, MD

Associate Program Director, Department of Emergency Medicine, Allegheny General Hospital, Pennsylvania, PA

Kara Iskyan, MD

Chief Resident, Emergency Medicine/Internal Medicine Residency, Department of Emergency Medicine, Allegheny General Hospital, Pennsylvania, PA

Mara Aloï, MD

Program Director, Department of Emergency Medicine, Allegheny General Hospital, Pennsylvania, PA

Peer Reviewers

James M. Callahan, MD, FAAP, FACEP

Associate Professor of Clinical Pediatrics, Director, Medical Education Division of Emergency Medicine, Assistant Residency Director, Department of Pediatrics, The Children's Hospital of Philadelphia, University of Pennsylvania School of Medicine, Philadelphia, PA

Kevin Reed, MD, FACEP, FAAEM

Assistant Professor of Emergency Medicine, Georgetown University and Washington Hospital Center, Department of Emergency Medicine, Washington, DC

Paula Whiteman, MD

Medical Director, Pediatric Emergency Medicine, Encino-Tarzana Regional Medical Center; Attending Physician, Cedars-Sinai Medical Center, Los Angeles, CA

CME Objectives

Upon completion of this article, you should be able to:

1. Identify clinical characteristics of patients with retained foreign bodies.
2. Select the appropriate removal technique for a variety of retained foreign bodies.
3. Recognize specific foreign bodies and clinical scenarios mandating emergent removal.

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Andy Jagoda, MD, FACEP

Professor and Vice-Chair of Academic Affairs, Department of Emergency Medicine, Mount Sinai School of Medicine; Medical Director, Emergency Medicine Department, Mount Sinai Hospital, New York, NY

Tommy Y. Kim, MD, FAAP

Assistant Professor of Emergency Medicine and Pediatrics, Loma Linda Medical Center and Children's Hospital, Loma Linda;

Attending Physician, Emergency Medicine Specialists of Orange County and Children's Hospital of Orange County, Orange, CA

Brent R. King, MD, FACEP, FAAP, FAAEM

Professor of Emergency Medicine and Pediatrics; Chairman, Department of Emergency Medicine, The University of Texas Houston Medical School, Houston, TX

Robert Luten, MD

Professor, Pediatrics and Emergency Medicine, University of Florida, Jacksonville, FL

Ghazala Q. Sharieff, MD, FAAP, FACEP, FAAEM

Associate Clinical Professor, Children's Hospital and Health Center/University of California, San Diego; Director of Pediatric Emergency Medicine, California Emergency Physicians, San Diego, CA

Gary R. Strange, MD, MA, FACEP

Professor and Head, Department of Emergency Medicine, University of Illinois, Chicago, IL

Christopher Strother, MD

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Adam Vella, MD, FAAP

Assistant Professor of Emergency Medicine, Pediatric EM Fellowship Director, Mount Sinai School of Medicine, New York, NY

Michael Witt, MD, MPH, FACEP, FAAP

Medical Director, Pediatric Emergency Medicine, Elliot Hospital Manchester, NH

Research Editor

V. Matt Laurich, MD

Fellow, Pediatric Emergency Medicine, Mt. Sinai School of Medicine, New York, NY

Children are incredibly curious about the openings in their bodies, and at the same time, they are fascinated by the many small objects they find in the world around them. This combination may lead to foreign objects becoming lodged in a variety of body orifices. When faced with young patients with retained foreign bodies, the emergency clinician should remember the old adage "*Primum non nocere*" (first do no harm). Although retained foreign bodies can cause complications, ill-prepared removal attempts with improper equipment on an uncooperative child may also lead to unanticipated problems and unfortunate outcomes.

This article reviews the management of retained foreign bodies in the ear, nasal cavity, aerodigestive tract, rectum, and vagina of pediatric patients. The goals of this review are to provide clinicians with a road map for managing cases of retained foreign bodies in their daily practice and to recommend instances when referral to an otolaryngologist, gastroenterologist, or other appropriate specialist is warranted.

Critical Appraisal Of The Literature

Ovid MEDLINE®, PubMed, and the Cochrane Database of Systematic Reviews were searched for articles on foreign bodies of the ear, nasal cavity, aerodigestive tract, rectum, and vagina in the pediatric population. Fortunately, the vast majority of articles on retained foreign bodies focus on pediatric patients. Articles published prior to 2002 were used only if they highlighted a unique complication or removal procedure. Most information was derived from retrospective case reviews and case reports. Over 570 articles were identified, with 395 being reviewed, and 101 ultimately being included in this article.

Epidemiology, Etiology, And Pathophysiology

Unless a child is preverbal or fearful of punishment, he or she will usually admit to ingesting an object or placing it into a body orifice. Unfortunately, the act may go unnoticed until inflammation or other symptoms or complications (typically a foul-smelling discharge or discomfort in the area) develop. Presentations of retained foreign bodies are described below.

Foreign Bodies Of The External Auditory Canal

In younger children, beads, plastic toys, pebbles, and popcorn kernels are the most common objects inserted in the ear.³ According to limited data, children who have an underlying middle-ear problem such as Eustachian tube dysfunction or otitis media with effusion are more likely than healthy children to insert objects into the auditory canal, ostensibly

to relieve irritation.¹ In children older than 10 years, insects are the most common foreign body found in the ear. Often, patients with a retained foreign body in the external ear are asymptomatic, with the object found incidentally during an examination.³ Symptoms may include pain, hearing loss, otorrhea, or a sensation of ear fullness. Intractable hiccups or coughing have also been reported as the only symptom of a foreign body in the external auditory canal.²

Nasal Foreign Bodies

Nasal foreign bodies account for 0.1% of pediatric emergency department visits and are most often seen in the 2- to 5-year age group.^{4,5} Similar to foreign bodies found in the ear, corn kernels, beans, beads, plastic toys, and pebbles are the most common objects placed in the nose by children.⁶ In one retrospective review, 86% of patients presented within 48 hours of insertion. The remaining 14% were discovered as an incidental finding.⁷

Aerodigestive Foreign Bodies

The placement of foreign bodies in the mouth is particularly concerning in the pediatric population. Inhalation of material into the respiratory tract can cause death by asphyxiation, whereas swallowing objects may cause significant injury to the digestive tract. According to CDC data from 2001, 17,537 children under the age of 13 presented to U.S. EDs with complaints related to choking. Of these patients, 10,438 choked on food, including 3325 who choked on gum or candy, 5513 children ingested nonfood items, and 2229 choked on coins.⁸ Boys and girls presented in similar numbers. Infants younger than 1 year were the most commonly affected age group, with incidence inversely proportional to age thereafter.

Swallowed Objects

In 2002, the American Association of Poison Control Centers reported 119,323 cases of foreign body ingestions.⁹ Seventy-five to 80% of these cases occurred in the pediatric population.^{9,10} Fortunately, 80% of ingested objects will pass through the gastrointestinal (GI) tract without incident.^{11,12} Objects lodged in the esophagus, however, are associated with significant risk of injury. Sadly, esophageal foreign bodies have been reported to cause more than 1500 deaths per year.¹⁰ Potential complications of swallowed foreign bodies caught in the esophagus include mediastinitis, pneumothorax, tracheoesophageal fistula, or aorto-esophageal fistula.¹¹ In contrast to esophageal foreign bodies, objects located in the stomach at the time of diagnosis are likely to pass without complications.

Physicians should be aware of situations in which objects are unlikely to pass or injuries are more likely to occur. The size and shape of objects

determines their ability to pass spontaneously. Objects more than 2 cm wide will not pass through the pylorus or ileocecal valve, and objects longer than 5 cm will not pass through the duodenum.¹³ In infants, any object longer than 3 cm is considered unlikely to pass and typically requires urgent removal.¹⁴ Sharp objects generally should be removed as they have a very high rate of perforation (up to 35%).^{12,13} Case reports of ingested toothpicks have described pericardial tamponade and coronary artery injury.¹² Nigri et al reported a case where a swallowed toothpick migrated through the duodenum and the resulting inflammatory reaction encased the right ureter leading to a renal colic type of presentation.¹¹

Coins represent perhaps the most common ingestion in the pediatric population.^{15,16} Poison control centers receive 3000 reports of swallowed coins each year.¹⁷ Most coins pass without intervention or problems.¹⁶ The vast majority of complications arise when coins become lodged in the esophagus and include airway obstruction, esophageal perforation, esophageal-aortic fistulas, and tracheoesophageal fistulas.^{16,17} The risk of damage increases the longer the coin remains in the esophagus.¹⁰

Inhaled Objects

Children between 1 and 3 years of age are most prone to inhaling foreign bodies.¹⁰ In fact, foreign body inhalation is the most common cause of accidental death in children under 1 year of age.¹⁸ In 2000, inhaled foreign bodies accounted for 160 deaths from respiratory compromise in children younger than 14 years in the U.S.⁸ Immature dentition, limited swallowing reflexes, running with objects in the mouth, and oral curiosity have been blamed for this phenomenon.¹⁹ Peanuts, seeds, and beans are commonly inhaled items, as are small toys.²⁰

Children and infants may have minimal symptoms related to airway foreign bodies, and the objects may go unnoticed for weeks or months.¹⁰ Cinar et al reported the case of a 10-year-old patient who was treated for a month with a working diagnosis of asthma and was ultimately found to have a small bone lodged in her larynx.²¹ Fortunately, the patient did not experience permanent complications from this episode. Clinicians need to maintain a high level of suspicion for inhaled foreign bodies early in any pediatric examination to prevent complications such as pneumonia, atelectasis, and the formation of granulation tissue, which represents a significant bleeding risk.¹⁰ A dreaded complication of inhaled foreign bodies is acute fatal airway obstruction, which occurs when an object shifts promptly from a nonventilated, nonperfused area to a perfused area, causing a sudden drop in blood oxygenation.¹⁰

Vaginal And Rectal Foreign Bodies

In an analysis of 48,058 children evaluated at a walk-in clinic at The Children's Hospital of Philadelphia, Paradise and Willis found the incidence of vaginal foreign bodies in girls younger than 13 years was 4%.²² No other study evaluating the epidemiology of pediatric vaginal foreign bodies was found in the literature. The most common vaginal foreign body reported in prepubertal girls is toilet paper.²³⁻²⁵ Other common foreign bodies include marbles, beads, toys, crayons, coins, stones, hair pins, and fruit pits.²⁵⁻²⁷

The time from insertion to symptoms and subsequent extraction of vaginal foreign bodies varies greatly. An inflammatory response of the vaginal walls may cause a papillary growth of mucosa around the foreign body.²⁴ Consequently, vaginal foreign bodies may be retained for long periods (in one extreme case, 20 years after insertion) before symptoms or identification of the object.²⁸ Unfortunately, many girls may also tolerate symptoms for a long time before seeking treatment. A study by Stricker et al of 35 girls with vaginal foreign bodies indicated that although 60% exhibited symptoms for less than 1 month before treatment, 11% of girls had symptoms for more than a year prior to evaluation and treatment.²⁷ Reasons for the delay in diagnosis are multifactorial and include a poor or unclear history, anxiety, denial, fear or embarrassment about vaginal complaints (by parents and children), difficulty performing a thorough physical examination of a child, and multiple evaluations before the foreign body is found.^{26,29,30}

Vaginal foreign bodies are usually self-inserted as a result of childhood curiosity or modeling behavior (eg, after watching a mother place a tampon) or in the case of adolescents, for sexual stimulation.³¹ Stricker et al found that in 25% of cases, the foreign body was placed into the vagina by someone other than the child. Of these cases, 80% involved insertion by friends of similar age (usually 3-5 years old) while playing "doctor"; the remaining 20% (overall, 5% of all vaginal foreign bodies) were considered to be the result of sexual abuse.²⁷

A paucity of literature exists regarding pediatric rectal foreign bodies. Most information was gleaned from a handful of articles on pediatric anorectal injuries and application of knowledge from the management of rectal foreign bodies in adults. Rectal foreign bodies in children typically result from ingestion of the object, iatrogenic causes (such as thermometers, enema tips, and catheters), or impalement.^{32,33} The origin of rectal foreign bodies in children differs from that of adults in that placement of items by children is usually accidental and unrelated to sexual stimulation. Ingestion of objects in children and adolescents is usually accidental or done unconsciously.³³

Many objects pass through the intestines and anus without difficulty, but occasionally a foreign body may become lodged in the rectum or surrounding areas. Fish bones, chicken bones, shellfish, and toothpicks are commonly ingested objects that lodge in the rectum.³³

The rare rectal impalement usually involves foreign body trauma to the anus or rectum and results in intraperitoneal or extraperitoneal rupture. Impalement is usually the result of sexual abuse or a fall from a high place onto a vertically oriented object such as a picket fence.³⁴ The foreign object may enter directly through the anorectal canal or through the perineum and buttock first. This type of injury can cause extensive rectal and intra-abdominal disruption.

Differential Diagnosis

Aerodigestive foreign bodies should always be considered when a child presents with unexplained dyspnea, coughing, or swallowing difficulties. Other etiologies to consider include pneumonia, bronchiolitis, and medical causes of stridor and respiratory distress such as croup, asthma, or allergic reactions.

The differential diagnosis for aerodigestive foreign bodies is listed in **Table 1**, the differential diagnosis for vaginal foreign bodies is listed in **Table 2**, and the differential diagnosis for a rectal foreign body is shown in **Table 3**.

Table 1. Differential Diagnosis For An Aerodigestive Foreign Body

- Pneumonia
- Bronchiolitis
- Allergy
- Croup
- Asthma
- Upper respiratory tract infection
- Gastritis
- Epiglottitis
- Deep space infections of the neck

Table 2. Differential Diagnosis For A Vaginal Foreign Body^{24,29,32,35-37}

- Vulvovaginitis (common sources include fecal contamination, poor hygiene, and local irritants)
- Infection (including sexually transmitted infections and overgrowth of gastrointestinal or vaginal flora)
- Vulvar skin disease
- Malignant vaginal tumors
- Sexual abuse
- Trauma
- Precocious puberty
- Anatomical anomaly
- Labial agglutination

Prehospital Management

When prehospital providers encounter children or infants with potential aerodigestive foreign bodies, the most important concern should be treating acute airway issues. The initial treatment of acute airway obstruction in infants should be 5 back blows alternating with 5 chest thrusts until the airway is cleared. In older children, the Heimlich maneuver should be used.^{39,40} Data on the use of the Heimlich maneuver in adults suggest a high rate of effectiveness, with an 86.5% success rate in one prehospital study.⁴¹ When foreign bodies are lodged in the nasal cavity or vaginal and rectal areas, epistaxis and vaginal or rectal bleeding should be controlled with pressure and intravenous (IV) fluid support as needed.

Emergency Department Evaluation

External Auditory Canal And Nose

Referral of all children with foreign bodies in the external auditory canal to an otolaryngologist is not feasible or necessary. Decisions about which patients should be referred depend on several factors. Clinicians should initially determine the location of the object within the ear canal. Foreign bodies lodged in the medial two-thirds of the canal are most difficult to remove, as this area is narrow and lined with sensitive skin, making patient cooperation with removal attempts very challenging. In addition, this area is close to the tympanic membrane, and attempts at removal are associated with a high rate of injury to this structure.⁴² Characteristics of the foreign body are also important in referral decisions. Objects that are spherical and/or smooth are the most difficult to remove without appropriate tools. In a review of 698 cases of foreign bodies in the external auditory canal, removal of irregular and soft objects was most often successful, as they were easily grasped with forceps and other tools routinely available in the ED.⁴³ This review also indicated that the probability of successful removal decreased drastically after the first failed attempt, with the number of complications increasing with subsequent attempts. Another review examining the difference between nongraspable (ie, smooth surfaced) and graspable (ie, ir-

Table 3. Differential Diagnosis For A Rectal Foreign Body^{32,33,38}

- Hemorrhoids
- Abscess
- Fissure
- Fecal impaction
- Rectal prolapse
- Infections (such as pinworms or sexually transmitted diseases)
- Poor hygiene

regularly shaped) objects found that the removal of nongraspable foreign bodies was associated with a complication rate of 70% and an overall success rate of 45%. In contrast, removal of graspable (irregularly-surfaced) objects had a significantly lower complication rate of 14%. The rate of successful removal of these objects was 64%.⁴⁴ Together, these studies reinforce the need for clinicians to consider both the characteristics of the object and the physical examination findings when choosing the most appropriate treatment plan for patients with external auditory canal foreign bodies.

Children who present with unilateral odiferous nasal drainage should be evaluated for a retained foreign body within the nasal cavity. Parents may also report that the child has halitosis. Nearly 50% of children in 1 study who were ultimately found to have a retained nasal foreign body had no known history of insertion.⁶ Nasal foreign bodies are most often found on the floor of the nares below the inferior turbinate or anterior to the middle turbinate. Although most nasal foreign bodies are placed there intentionally by the child, occasionally objects are propelled into the nares by coughing after oral ingestion.⁴⁵ These cases may lead to delayed diagnosis, as the search for the foreign body initially may focus on the lower aerodigestive tract. Although rare, presenting symptoms may include headache, facial pain, or sneezing. Any epistaxis is typically due to attempts at removal prior to ED presentation.

The majority of nasal foreign bodies can be successfully removed in the ED. In a retrospective review of 60 patients presenting for removal of an object in the nose, only 1 patient required consultation with an otolaryngologist and fiber-optic endoscope-assisted removal. The remaining objects were removed using techniques and equipment available to the ED clinician.⁶

Inhaled Foreign Body

The history of patients presenting with an inhaled foreign body typically includes an episode of choking or gagging followed by coughing. Symptoms may subside as the object moves into a deeper position. The patient history is the most important factor in determining the presence of a foreign body in the airway, with some authors reporting 91% sensitivity and 46% specificity.¹⁰ When the history was suggestive of an inhaled foreign body despite normal findings on physical examination and negative results on radiograph, incidence of a foreign body was 45%. Therefore, a suggestive history alone should be considered a reasonable indication for bronchoscopy.¹⁰

In a 2006 retrospective study, Tomaske et al reported on the diagnostic value of signs, symptoms, and radiographic findings in 370 patients who underwent bronchoscopy for potential tra-

cheobronchial foreign body inhalation.⁴⁶ The average age of the patients was 1.8 years. Patients were split into 2 groups on the basis of duration of symptoms (ie, less than 2 weeks or more than 2 weeks), which explains the reporting of statistical ranges below. Symptoms highlighted in the study were a witnessed episode of aspiration, acute choking or coughing, and a permanent cough. Signs reported were stridor, wheezing, and unilaterally diminished breath sounds. In 59.7% of patients, a foreign body was found and removed. According to the authors, the clinical triad of acute choking on the history, wheezing and unilateral diminished breath sounds on examination, and unilateral hyperinflation on chest radiograph were the most valuable findings. Unilateral diminished breath sounds had a sensitivity of 75.1% to 79.4% for the presence of a foreign body (with a specificity of 68.1%-81.3%). Chest radiographs showing unilateral hyperinflation had a sensitivity of 53.1% to 60% and a specificity of 82.5% to 87.7%. The clinical triad mentioned above demonstrated a very high specificity of 96% to 98% but was relatively insensitive (26.5%-42.6%).⁴⁶ Chest radiographs showing unilateral hyperinflation had a sensitivity of 53.1% to 60% and a specificity of 82.5% to 87.7%.

In a 2009 prospective study published in the *Journal of Pediatrics*, Cohen et al attempted to define criteria for proceeding with bronchoscopy in children with potential foreign body aspiration.¹⁸ The authors evaluated 142 patients who were referred to a university hospital for bronchoscopy. Sixty-one of 142 patients had an airway foreign body. Of these 61 patients, 42 had abnormal results on both physical examination and radiographs, 17 had abnormal findings on either radiograph or physical examination but not both, and 2 patients had normal findings on physical examination and radiograph but histories of unexplained persistent cough. In asymptomatic patients with normal results on history, physical examination, and chest radiograph, none were found to have foreign bodies. The authors concluded that in children with a history of choking, bronchoscopy should be performed in those with persistent symptoms or with abnormal results on physical examination or radiographs.¹⁸

Swallowed Foreign Body

Children who swallow a foreign body may be unable or unwilling to give a clear or accurate history of the event. Clinicians should therefore maintain suspicion based on the caregiver's history and results of the physical examination. Outside of witness accounts of ingestion, historical cues that suggest a foreign body include irritability, upper respiratory infection symptoms, poor feeding, drooling, chest pain, trouble breathing, and coughing.¹⁰ Nevertheless, a substantial percentage of the pediatric popu-

lation (between 7% and 35%) with a GI foreign body may be asymptomatic after ingestion.^{9,10} In a 2008 retrospective study involving 212 Taiwanese pediatric patients with an average age of 4.5 years who ingested a foreign body, 57% were asymptomatic.⁴⁷ In the remaining patients, symptoms related to ingestion included vomiting (21%), drooling (15%), anorexia (7%), and coughing (5%).⁴⁷

During a physical examination, clinicians should look for evidence of complications related to the swallowed object. Thorough evaluation of the oropharynx may reveal an object or drooling or pooling of secretions in the mouth. Neck examination may reveal swelling, erythema, tenderness, or crepitus (if a perforation has occurred).¹² Stridor or wheezing resulting from compression of the adjacent airway may also be observed. In more severe cases, the abdominal examination should focus on signs of peritonitis or bowel obstruction.

Vaginal And Rectal Foreign Bodies

Vaginal Foreign Bodies

The history surrounding a vaginal foreign body is often difficult to elucidate for multiple reasons. A child may not acknowledge the introduction of the foreign body into her vagina. Stricker et al reported that in 35 girls aged 2 to 9 years with vaginal foreign bodies, only 54% recalled insertion.²⁷ Additionally, the child may be too young to articulate an accurate history.²⁹ Anxiety, denial, fear, or embarrassment by the child and parents are also often associated with vaginal complaints.^{26,48}

The most common symptoms of a vaginal foreign body are bleeding and discharge. Nevertheless, neither vaginal bleeding nor vaginal discharge is always indicative of a foreign body. In a retrospective evaluation of 24 girls with vaginal bleeding or discharge, 15% of patients with vaginal bleeding had a foreign body.²⁹ Similarly, a 1985 study of 45 girls with vaginal complaints used Bayes theorem to determine that 18% of girls with vaginal bleeding had a foreign body (sensitivity 93%, specificity 82%).²² Vaginal discharge is associated less often with a vaginal foreign body. In several analyses, around 10% of girls presenting with vaginal discharge were found to have a vaginal foreign body.^{22,49} A study by Striegel et al reported that 45% of girls with vaginal discharge had a foreign body, but this finding was likely due to referral bias, as all patients had been evaluated and unsuccessfully treated by primary care physicians before the object was finally detected.²⁹

In addition to bleeding and discharge, patients with vaginal foreign bodies may complain of vaginal odor, abdominal pain, genital pruritus, erythema, and dysuria.²⁷ Recurrent urinary tract infections, recurrent vaginal discharge, or vaginitis despite adequate treatment should prompt evaluation for a

vaginal foreign body.^{24,48,50} Although rare, a vaginal foreign body may present with serious complications such as fistulas (commonly vesicovaginal but also rectovaginal, urethrovaginal, or ureterovaginal), vaginal stenosis, or scarring.²⁸

A thorough physical examination and diagnostic evaluation for a suspected vaginal foreign body may pose significant challenges in the pediatric population because of psychological stress and technical difficulties.²⁹ The physical examination is better tolerated if the clinician first develops a rapport with the child. An initial "show and tell" technique with instruments that will be used in the examination can help to alleviate anxiety.²⁵ The best visualization of the vagina occurs with the patient in the lithotomy, or frog-legged, position, but a knee-to-chest position with a Valsalva maneuver and gentle separation of the labia can also be used.²⁵ In addition to allowing visualization of the foreign body, the examination should focus on any signs of abuse (discussed in the Special Circumstances section) and abdominal or genital abnormalities. A rectal examination should also be performed. Stricker et al found that 34% of vaginal foreign bodies were seen on inspection of genitalia or palpated on rectal examination.²⁷

Together, the history and physical examination are often sufficient to diagnose a vaginal foreign body. In one study, more than 91% of vaginal foreign bodies were suspected and identified on the basis of at least one of the following findings: recall of insertion of a vaginal foreign body, vaginal bleeding, blood-stained vaginal discharge, foul-smelling discharge, visualization of the object on genital inspection, or palpation on rectal examination.²⁷ Clinicians should keep in mind that more than one foreign body may be involved, and a second visualization is recommended after removal of the initial object.

Rectal Foreign Bodies

When a child has rectal complaints and the examination reveals no common cause such as a fissure or abscess, a high index of suspicion should be maintained for a foreign body.³⁸ Rectal foreign bodies are most commonly due to ingestion.³⁸ Because the period between ingestion of an object and appearance in the rectum can be up to 2 weeks, most children will not relate the rectal discomfort to a previous ingestion.³³ Similar to patients with vaginal trauma, patients with rectal foreign bodies often lack the clinical history for impalement or sexually related trauma, or the history is inaccurate because of embarrassment.³⁸

The most common complaints related to rectal foreign bodies are anal pain or pelvic discomfort, abdominal pain, rectal bleeding, obstipation, and possible peritonitis.^{33,38} Digital rectal examination

often identifies the object. Other rectal examination findings include damage to the anal canal, lax anal sphincter, and bloody or mucoid rectal discharge.^{32,38} The lack of physical findings after ingestion or rectal impalement does not rule out intra-abdominal trauma, and any peritoneal signs warrant further evaluation. A thorough physical examination under anesthesia may be required depending on the patient's tolerance.³⁴

Diagnostic Studies

Identification of foreign bodies within the external auditory canal and nose rarely requires diagnostic studies. Nevertheless, plain radiographs can be useful for identifying a nasal or aural foreign body when there is no history of insertion, an object is not visible on examination, and/or the patient presents with signs of irritation such as foul-smelling discharge or pain.⁷

Chest radiographs are limited in detecting airway foreign bodies since 80% of airway foreign bodies are radiolucent.¹⁰ Other findings such as air trapping seen as unilateral hyperinflation on expiratory film and atelectasis can be helpful in making the diagnosis. Similarly, more than half of tracheal foreign bodies and 25% of bronchial foreign bodies will not be detected on chest radiographs.¹⁰

Ingested coins pose a particular challenge. Typically, esophageal coins appear round en face on an anterior-posterior (AP) or posterior-anterior (PA) chest radiograph.¹⁰ (See Figure 1.) The pliable and muscular esophagus sits against the flat anterior aspect of the spinal column, allowing the coin to lay flat against the bone.¹⁰ In contrast, Raney and Losek reported a case in 2008 where a coin appeared on edge in the AP view, but a lateral radiograph showed the coin located posterior to the trachea; this

Figure 1. Posterior-Anterior View



PA view of a child with a coin in the upper esophagus. Image is courtesy of Dr. Brian Rempe.

finding highlights the importance of performing a lateral view as well.¹⁶ (See Figure 2.) Although rarely aspirated into the trachea, once there, coins tend to appear on edge. The vocal cords are arranged as a narrow front-to-back opening, so that coins tend to enter and lodge in this position. In addition, the tracheal cartilage ring has a muscular back wall and relatively large AP diameter, causing coins to appear sideways on AP and PA radiographs.⁹ As an alternative to radiographs, some centers report using metal detectors to localize coins.⁵¹

The primary diagnostic and therapeutic method for vaginal foreign bodies is a pelvic examination with vaginoscopy.²⁹ However, given the stress to the patient, the medical resources required, and the risks of anesthesia, noninvasive methods of diagnosis are preferred. Unfortunately, the overall sensitivity of noninvasive studies (including plain film, ultrasound, computed tomography [CT], and magnetic resonance imaging [MRI]) in detecting vaginal foreign bodies is only 71%. Consequently, no single diagnostic study can be recommended as a definitive modality.²⁹ Radiographs are usually non-diagnostic because the objects must be radiopaque or large enough to displace normal anatomic structures. However, this method may be considered for vaginal irrigation if a high clinical suspicion of a foreign object exists.^{23,24,31} Although abdominal ultrasound is well tolerated by young girls, support for this modality is split. Ultrasound fails to detect most vaginal foreign bodies, but certain findings,

Figure 2. Lateral View



Lateral view of a child with a coin in the upper esophagus. Image is courtesy of Dr. Brian Rempe.

such as indentation of the posterior bladder wall and echogenic and acoustic shadowing, can indicate the presence of an object.⁵² Computed tomography is often a poor choice because of the significant radiation dose and possible need for IV and IV dye exposure. An MRI increases the localization of nonmetallic objects missed by other radiographic studies but has limited availability, may be inconclusive, and may require heavy sedation or general anesthesia, which has associated risks.^{24,49}

In contrast to vaginal foreign bodies, a rectal foreign body can frequently be diagnosed on plain film unless the object is radiolucent or too small. Additional benefits of this method include evaluation for perforation and object localization and identification.^{32,33,38} Given the potential for intra-abdominal injuries with rectal impalement, patients may require additional follow-up studies such as a proctosigmoidoscopy to evaluate the rectal mucosa, a water-soluble enema to delineate perforation, or a cystoscopy to determine the presence of bladder injury.³⁴ Surgical consultation is warranted for these patients.

Treatment

Foreign Bodies Within The External Auditory Canal Or Nasal Cavity

Patient Preparation

Before removal of a nasal foreign body is attempted, premedication with lidocaine 1% is recommended to limit the patient's discomfort during the procedure. The maximum dose of lidocaine without epinephrine is 3 mg/kg. The use of phenylephrine 0.5%, oxymetazoline 0.5%, or other topical vasoconstrictor is not uniformly recommended. Some authors cite the risk of posterior displacement with these agents as a reason not to use them.⁴ Others believe that vasoconstrictors reduce the amount of soft tissue swelling around the foreign body and aid attempts at removal.⁵³ Ear, nose, and throat (ENT) specialists

commonly use a combination of anesthetic agent and topical vasoconstrictor. No topical agents should be used in cases involving button batteries, however, because of complications from the battery interacting with these solutions.

Pretreatment with topical vasoconstrictors or anesthetic agents is not needed in the external ear canal. Auricular blocks with local anesthetics, which result in anesthesia of the external auditory canal, are also not recommended, as the multiple punctures required in an uncooperative child can cause physical and mental trauma. For removal of the foreign body, many experts recommend seating the child in the parent's lap with his or her arms and torso secured by the parent.³ Another staff member should immobilize the child's head. If the child is not able to be adequately soothed or restrained, sedation should be considered. (Note: A review of the agents available for short sedation procedures is beyond the scope of this article.) Emergency clinicians should choose an agent based on patient characteristics and hospital guidelines and policies, as well as their own clinical experience. If possible, tympanic membrane perforation should be ruled out with the use of pneumatoscopy before removal of the foreign object is attempted.

See **Table 4** for a comparison of techniques for removal of foreign objects from the ear and nose.

Techniques For Removal Of Foreign Objects

Irrigation with warm water using a 14- or 16-gauge angiocatheter with a 30- or 60-mL syringe can be useful for removal of certain objects within the ear canal. (See **Figure 3.**) For irrigation of foreign objects within the nasal cavity, a bulb syringe filled with 7 mL of sterile normal saline solution has been used. Lichenstein and Guidice described forcibly squeezing saline into the contralateral nostril and successfully dislodging the retained objects in 3 patients.⁵⁴ Irrigation is not recommended for

Table 4. Techniques For Removal Of Foreign Objects From The Ear And Nose^{42,46}

Technique	Advantages	Disadvantages
Forceps (or other direct instrumentation)	Readily available in most emergency departments	Not ideal for hard, smooth, fragile, or spherical objects
Suction catheter	Ideal for hard, smooth, or spherical objects in the lateral one-third of the external canal	Requires direct visualization of object and good seal over object for appropriate suction
Curved hooks	Ideal for hard, smooth, or spherical objects in the lateral one-third of the external canal	Inadequate space for passage of hook beyond object when edema is present in surrounding tissue; risk of tympanic membrane perforation
Positive pressure technique	Used for objects in the nose only; well-tolerated by pediatric patients; lower risk of traumatic complications than other techniques	Small risk of barotrauma, especially when external oxygen source is used to deliver pressure
Magnets	Relatively atraumatic removal technique	Only for use with metallic objects

extraction of vegetable matter or any absorbent material, however, as it will cause swelling of the foreign body and make removal even more difficult. In addition, irrigation is contraindicated for removal of retained button batteries.

Forceps/Other Direct Instrumentation

A variety of instruments (eg, alligator forceps, bayonet forceps, mosquito clamps, and hemostat clamps) may be used to grasp foreign material observed in the anterior nose or lateral third of the external auditory canal. (See Figure 3.) Their use is limited when the object is smooth or round because of the potential for pushing the object further into the canal. In addition, some fragile material such as paper, cotton balls, or vegetable matter may fragment when grasped and pulled, resulting in incomplete removal of these objects.

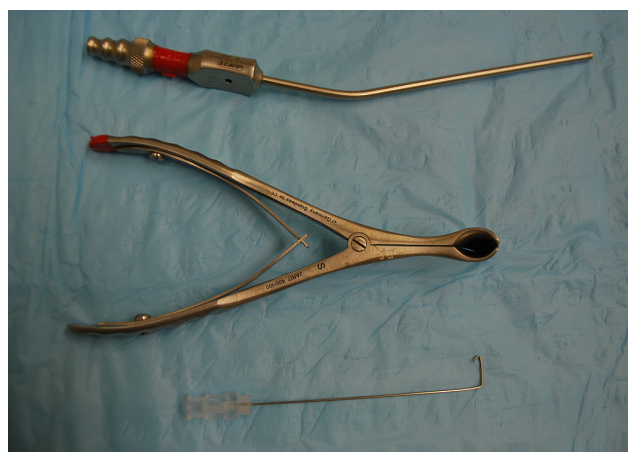
Suction Catheter

A Schuknecht tube or Frazier tip attached to suction can be used to remove some objects from the external auditory canal and nose. A solid seal must be formed between the end of the instrument and the object to allow for removal. Most commonly, a suction pressure of 100 to 140 mm Hg is required. (See Figure 3.)

Balloon Catheter

For objects in the posterior nasal cavity or those with a spherical shape or smooth surface, a small Foley (5-, 6-, or 8-French) or Fogarty catheter may be used for removal. Commercial products designed especially for this purpose are also available. The tip of the catheter should be inserted into the nasal

Figure 3. Tools For External Auditory Canal/ Nasal Foreign Body Removal



Sample of tools used for external auditory canal and/or nasal foreign body removal; (from top to bottom) Frazier suction tube, pediatric nasal speculum, ED-made right angle hook. Photo is courtesy of Dr. Mara Aloï.

cavity after lubrication with lidocaine gel. The balloon should be inflated with 2 to 3 cc of air once the tip is past the object, and the catheter should then be withdrawn slowly, with eventual delivery of the foreign object from the nose. If the catheter is unable to pass beyond the object, another removal technique should be considered as the foreign body is likely too large and is completely occluding the nasal passage. However, in patients with foreign bodies with the appropriate characteristics, a success rate of more than 90% has been reported with the balloon catheter method.⁵⁵

Hooks

Right angle or curved hooks, curettes, wire loops, or unbent paper clips may be used for the removal of nongraspable objects in the lateral internal auditory canal or anterior nares. (If a right-angle hook is not available in the ED, one can be made by using a small artery forceps or needle holder to modify a spinal needle or a 21- or 22-gauge needle into the appropriate shape.⁵⁶ Sandpaper can be used to dull any sharp edges.) Similar to the Foley catheter technique, this method requires the passage of the

Figure 4. Male-To-Male Adapter



Male-to-male adapter (5-in-1-connector). Photo is courtesy of Dr. Mara Aloï.

Figure 5. Positive Pressure Technique



Male-to-male adapter inserted into contralateral nostril to dislodge foreign object from the nose. Suction tubing is attached to wall oxygen source at 15 L/min. Photo is courtesy of Dr. Mara Aloï.

hook past the foreign object. The object can then be pulled forward out of the cavity. These instruments are associated with a higher rate of bleeding from mucosal injury, however, as they have to be inserted and rotated, and then traction must be applied.⁵⁷ (See Figure 3.)

Positive Pressure Technique (Nasal Foreign Bodies)

Numerous variations of this technique are possible, with the common principle being the application of positive pressure over the mouth or unaffected nasal passage to force out the retained foreign object from the affected nostril. The following techniques may be used.

- A bag-mask device connected to high-flow oxygen may be placed over the patient's mouth to provide positive pressure while the operator occludes the unaffected nare by applying external pressure with the hand. When positive pressure is delivered, the force should push the foreign object anteriorly, either completely out of the nasal passage or at least into visible range where it may be grasped with other instruments.⁵⁸
- Pressure applied through the contralateral nostril can also lead to successful removal of a nasal foreign body. In place of the bag-mask device, which may upset the child, the Beamsley-Blaster technique uses commonly available male-to-male adapters and oxygen tubing connected to a wall oxygen source.⁵⁹ The adapter is inserted into the nonoccluded nostril while the patient's mouth is held shut (either by the patient or the operator, depending on patient cooperation). Oxygen flow at 10 to 15 L per minute should generate enough pressure to dislodge the foreign body. (See Figures 4 and 5, page 9.)
- Positive pressure can also be provided by the parent sealing the child's mouth with his or her mouth (also known as a "parent's kiss") and delivering a quick, forceful puff of air. This method is credited to Dr. Ctibor in 1965.⁶⁰ In one case series, this method was found to be highly effective in 15 of 19 patients.⁵ In a prospective observational study done in 2008, this technique was successful in 65% of cases. A higher success rate was found for objects which were small, smooth, and spherical.⁶¹ This procedure is often less distressing for the child because the parent performs the procedure and no instruments are used.
- A modification of the parent's kiss method involves placing one end of a straw in the child's mouth with the other end in the parent's mouth.⁶² The parent is instructed to deliver a short, sharp puff of air while occluding the contralateral nostril. The child is instructed to close the lips tightly around the straw. Obviously this method requires cooperation from the child, but it is thought to be preferred by parents who may

not be comfortable giving children mouth-to-mouth kisses.

Although positive pressure techniques pose a theoretical risk of barotrauma to the lungs, tympanic membrane, or other tissue, only one such case has been reported in the literature, with eye barotrauma and periorbital subcutaneous emphysema as complications. In this particular case, the male-to-male adapter method was used.⁶³ To decrease the risk of complications, a maximum of 4 attempts at removal using any of these positive pressure techniques has been recommended, although no data have been presented to support this recommendation.⁶⁴

Magnets

If they are available in the ED, magnets can be very efficacious in the removal of metallic objects such as ball bearings or button batteries from both the nares and the external auditory canal.^{65,66} Magnets are particularly useful when the patient has a significant amount of mucosal swelling, which tends to be friable. Bleeding of the friable mucosa may occur after use of other equipment, whereas magnets allow for atraumatic removal of appropriate objects.

After removal of an object from the external auditory canal, topical antibiotics should be considered if there is associated otitis externa or if trauma to the canal is apparent.

Airway Foreign Bodies

Traditional treatment for airway foreign bodies involves rigid endoscopic removal of the object.²⁰ Use of the endoscope allows for ventilation and protection of the airway while the larger lumen aids removal of the object. Flexible bronchoscopy has recently been studied for this purpose as well. Potential limitations of this technique include a narrow suction channel and the need to remove the object and the scope together, making the patient's airway vulnerable if the object is dropped during extraction. Swanson et al reported on 94 children who underwent a bronchoscopy for suspected airway foreign body from 1990 to 2001 at Mayo Clinic. Thirty-nine children were found to have tracheobronchial foreign bodies. Flexible bronchoscopy was successfully used to remove foreign bodies in all 26 patients from 1994 through 2001 without significant complications. This included 2 patients in which attempts at rigid bronchoscopy had failed. The other 13 foreign bodies were removed with rigid bronchoscopy alone. The authors concluded that flexible bronchoscopy is a reasonable first option but that rigid bronchoscopy or emergent tracheostomy should be available to handle episodes of acute airway compromise.²⁰

In patients with airway foreign bodies, emergent consultation with specialists is prudent. In a retrospective study published in the International Journal

of Pediatric Otolaryngology, Mani et al examined timing of removal of airway foreign bodies and its effect on rates of complications. Of 165 referred for possible airway foreign body, 14 had a very low suspicion for a foreign body and were treated without bronchoscopy. Fifty-seven patients had negative bronchoscopy; 7 underwent emergent bronchoscopy due to severe symptoms. Of the 87 remaining, 41 had bronchoscopy performed on the day of presentation while the remainder had the procedure the following day. The authors reported no additional complications in the group receiving a delayed procedure.⁶⁷ In summary, a brief delay before removal of airway foreign bodies may be acceptable. However, rapid worsening of symptoms can occur, and transfer to a higher level of care is generally recommended if the specialty services needed for definitive intervention are not available on-site in a timely fashion.

Esophageal Foreign Bodies

The wisdom of observing patients with esophageal foreign bodies for a specific time versus immediate removal of the object is debated in the literature.⁵¹ The technique for foreign body removal varies based on the facilities and available staffing. Four techniques commonly utilized include simple observation, Foley catheter manipulation, bougie manipulation, or direct endoscopy. Observation of pediatric patients with esophageal foreign bodies may be considered if there is no known history of structural or mechanical abnormality of the esophagus and the child is tolerating secretions. Observation may also be considered if the object is in the lower portion of the esophagus. In these cases and when close follow-up is available, the patient may be watched in the outpatient setting.¹⁰

Sharieff et al examined an institutional protocol for the management of children who had swallowed coins. If the coin was found to be below the thoracic inlet and ingestion occurred less than 24 hours prior to presentation, the child was sent home for an observation period. In 6 of 8 patients who met these criteria, the coin passed spontaneously within a 24-hour period.⁵¹ The authors concluded that patients presenting within 24 hours of ingesting a coin that subsequently becomes located in the mid to distal esophagus may be observed at home with next day follow-up and removal as needed.⁵¹ In the same study, 3 of 16 patients who had coins above the thoracic inlet were discovered to have passed them on pre-procedural scout film obtained prior to endoscopy. The authors recommend considering a 2- to 5-hour observation period in these patients because of this possibility of spontaneous passage.

If the foreign body has moved past the duodenum, observation is the approach of choice as these would not be amenable to removal via endoscope.¹³ Most objects will pass when they have reached the

stomach. In a case series involving 13 patients, Pavlidis et al reported only 1 patient requiring surgery. This was due to a coin lodged at the cecum causing a bowel obstruction. Ingested foreign bodies in the series included 2 coins, 5 sets of dentures, 3 nails, 2 needles, and 1 razor.¹³

Bougienage has been suggested as a less expensive and safer alternative to endoscopy.¹⁶ This process involves inserting a bougie (thin cylinder of rubber or plastic) into the esophagus in an attempt to dislodge an object. Dahshan and Donovan reported on 10 children (average age 3.2 years) with esophageal foreign bodies who were treated with bougienage. Time of treatment and costs were compared with those of 3 patients who qualified for the study but refused the treatment. Patients who underwent bougienage required little or no sedation and had no significant complications. Only 1 patient also required endoscopy. The average patient stay for those in the bougienage group was 2 hours versus 8 hours for those in the control group. The average cost was \$1200 per patient in the bougienage group versus \$3100 per patient in the control group.¹⁵

In 2008, *Annals of Emergency Medicine* published a large case series involving 620 pediatric patients with esophageal coins treated with bougienage.¹⁷ Of these patients, 41% were asymptomatic, 22% were anxious, 14% exhibited respiratory symptoms, and 36% presented with drooling, gagging, or vomiting. A total of 355 patients were successfully bougienaged in 372 attempts representing a 95.4% success rate. The procedure was performed without anesthesia and with the child simply wrapped in a sheet. The coins were successfully advanced into the stomach with the children discharged home to await passage into the stool. There were no serious complications. The authors pointed out that the average ED stay for bougienage was only 2.2 hours, and the average cost was \$1884. These data compare favorably with an average stay of 6.1 hours and an average cost of \$6087 in the group treated with endoscopy.¹⁷

Fluoroscopically guided Foley catheter removal is practiced at some centers. This requires endoscopic back-up to be present, as well as fluoroscopy. It can be performed on patients with no history of esophageal disease who swallowed a single, smooth object, which can be seen via fluoroscopy. As the object is to be pulled out the mouth, a risk would include airway obstruction.¹⁰

Success rates as high as 80% using a Foley catheter with endotracheal intubation to remove esophageal foreign bodies have been reported.⁶⁸ This was reported in Zambian hospitals which lack the capability to utilize fluoroscopy and is not recommended where more advanced techniques are available. This technique is advantageous because it does not require fluoroscopy (with resultant radiation exposure) or

other advanced equipment such as an endoscope.

Comparing observation to endoscopy for esophageal coins, a randomized, prospective study of 168 children was performed by Waltzman et al. Excluding patients who had swallowed a coin more than 24 hours prior to presentation, patients with previous tracheal or esophageal surgery or those who were symptomatic, 60 patients were randomized either to immediate endoscopy or a 16-hour observation period. Spontaneous passage of the coin occurred in 23% of patients in the observation group and 30% of patients in the early endoscopy group. There were no complications in either group. The authors concluded that a period of observation is a reasonable choice. Of note, coins in the distal third of the esophagus were much more likely to pass than those located proximally (56% versus 27%). Older children were also more likely to pass the coins. The authors recommend observation in those with distally located coins particularly in older children.⁶⁹

Hostetler and Barnard retrospectively reviewed the use of ketamine in the ED to facilitate the removal of esophageal foreign bodies.⁷⁰ The authors found that despite reports of ketamine-associated laryngospasm in esophageal procedures, no significant problems were reported in the 57 patients studied. Transient hypoxia was noted in only 10.7% of patients treated with ketamine, glycopyrrolate, and midazolam versus 15.4% of patients treated with fentanyl and midazolam. The length of stay was 3.7 hours with ketamine treatment versus 5.7 hours with use of fentanyl and midazolam.

Vaginal And Rectal Foreign Bodies

Vaginal foreign bodies are best treated with timely removal.³¹ Vaginal irrigation or lavage with normal saline, warm water, or a povidone-iodine solution is well tolerated in females over the age of 6 and is most effective if the object has been visualized (typically in the distal vagina or introitus).^{24,26,27,49}

Irrigation should not be attempted if the child is

Risk Management Pitfalls To Avoid

1. "After I had extracted one foreign body, I thought I was done."

Foreign bodies often come in multiples or may break apart in extraction. A thorough reexamination of all orifices is suggested after extraction of an object in a young child.

2. "I thought I could just irrigate the piece of popcorn out of her ear."

Irrigation of vegetable matter or other absorbent material within the external auditory canal is contraindicated, as these objects can swell when wet; removal attempts then become challenging, if not impossible, in the ED.

3. "The story seemed good, so I didn't even consider sexual abuse."

Any pediatric vaginal or rectal foreign body should raise the suspicion of sexual abuse. A thoughtful history and thorough examination can help determine the appropriate level of concern. Sexual abuse is more common than once thought, and ED clinicians miss many cases. Clinicians should have a low threshold for referral to an abuse expert.

4. "I didn't see a vaginal foreign body, so I figured nothing was there."

Foreign bodies can be lodged in the upper vagina, making them difficult to visualize. Unfortunately, vaginal foreign bodies are frequently missed on initial evaluation, only to be found upon later examination. If the diagnosis of a

vaginal foreign body is unclear or the physical examination is limited, a referral to an outpatient pediatric gynecologist is appropriate.

5. "The patient didn't recall or admit to introducing a rectal foreign body, so I didn't think the rectal pain could be due to a retained object."

Rectal foreign bodies are frequently ingested accidentally or are unconsciously inserted by a children. Suspicion that an ingested foreign body has migrated to the rectum is warranted if the rectal examination does not show any evidence of fissure or abscess.

6. "His mother said he swallowed a quarter, but he looked fine."

Up to 35% of children with an esophageal foreign body will be asymptomatic.¹⁰ The complications of esophageal foreign bodies can be severe if they are not removed in a timely fashion.

7. "His dad said he inhaled something and was choking, but I let him go because the radiograph looked fine."

Up to 35% of chest radiographs are negative for airway foreign bodies.^{10,19}

8. "These magnets are small enough to pass without a problem."

Multiple magnet ingestion has been associated with significant morbidity and even mortality because of the tendency of magnets to attract each other in the bowel, causing pressure necrosis.^{81,82}

uncooperative or if plain radiographs show an object that is large and nonmobile.³¹ The hymenal tissue is particularly sensitive, and care must be taken not to touch it with the catheter, or the pain may cause the child to become uncooperative. If the child is unaccommodating during lavage, procedural sedation and analgesia may allow for completion.⁴⁹ Attempting lavage in an uncooperative patient also risks hymenal or vaginal injury and emotional trauma. Toilet paper wads can be successfully removed in the ED by pretreating the vulva with viscous lidocaine and inserting a small Foley into the vagina for lavage. Afterward, parents should be encouraged to replace toilet paper in the home with moistened towelettes.³⁷

Vaginoscopy provides improved diagnostic capabilities and a method for extraction. Use of this instrument depends on the clarity of diagnosis, the location of the object in the vagina, and the success of vaginal lavage. In one series, 80% of girls with foreign bodies in the distal portion of the vagina required vaginoscopy. Importantly, 18 of 30 girls tolerated vaginoscopy without any anesthesia (the youngest was 3 years old).²⁷ Little evidence is available regarding the success or danger of extensive vaginal irrigation, sitz baths, or estrogen cream after foreign body removal.^{24,27} Regardless of the method chosen for removal, a repeated examination should be considered to evaluate for multiple foreign bodies.

Extraction of rectal foreign bodies is often more complicated than the removal of vaginal objects because patience and ingenuity are required. Nevertheless, most objects can be extracted in the ED.³² Success depends on the location of the object, its orientation in the colon, and its size.⁷¹ A foreign body in the mid or lower rectum is easier to remove than objects located elsewhere.⁷² If there is no evidence of perforation or peritonitis, foreign bodies in the upper rectum can either be observed, lowered manually, or extracted. Objects in the upper rectum usually descend to the lower rectum within 24 hours.⁷³ Enemas and gentle traction can assist in this process.⁷¹ Ultimately, objects in the upper rectum are 2.25 times more likely than those in the mid or lower rectum to require operative intervention for removal.⁷⁴

Sedation and analgesia are generally required for extraction from the rectum.^{32,75} In addition to medications given for systemic effect, local anesthetic delivered to the anal sphincter can help with relaxation and dilation.³² Objects in the rectum often create a vacuum distally that precludes extraction. One option is to maneuver a Foley catheter between the object and the mucosa to release the vacuum.^{32,73} The method of removal is limited only by creativity. Vaginal spatulas, suction devices, wire and plastic snakes, ring forceps, and magnets are among the instruments used to extract rectal foreign bodies.^{32,72,75,76}

Overall, 57% to 75% of rectal foreign bodies in adults can be extracted in the ED setting.^{33,74} In the

remaining cases, a surgeon may have to remove the object by laparotomy under deep sedation or general anesthesia. Even during a laparotomy, most rectal foreign bodies can be removed transanally. In 1 study, only 8% of rectal foreign bodies in adults required opening of the bowel and subsequent colostomy for removal.^{33,74}

After object extraction from the rectum, a repeated examination is required to determine mucosal and muscle injury and to ensure there are no other retained foreign bodies. Superficial, nonbleeding rectal injuries can typically be left to heal on their own. Injury involving the muscular wall requires surgical repair.³² Controversy surrounds the use of sigmoidoscopy versus a more limited follow-up examination and observation.^{32,33,74,75} Given the lack of consensus, either course of action appears appropriate, although this decision should be made with surgical consultation and input.

Patients with rectal impalement of foreign bodies should be considered high risk. In these cases, admission is required to monitor the patient for sepsis and intraperitoneal injury, delivery of a broad-spectrum antibiotic, and bladder decompression. An urgent surgical procedure for structural repair and a potential colostomy may also be required when this injury is identified in the ED setting.³⁴ Children with rectal foreign bodies or impalement injuries should receive a tetanus toxoid as appropriate⁷⁴ and should be offered psychological assessment and support.^{33,75}

Special Circumstances

Button Batteries

Button batteries are of special concern to the ED clinician because of their small size and toxic components. According to the National Button Battery Ingestion hotline and National Poison Control database, 3600 cases of button battery ingestion were reported in 2008.⁷⁷ The batteries are typically composed of zinc, silver, and mercury immersed in potassium hydroxide. Prolonged contact with soft tissues can lead to leakage of these contents and result in liquefactive necrosis. Electrical burns are also a possibility, as low-voltage direct current passes between the anode and cathode of the battery. In addition, direct pressure necrosis may develop. Perforation can occur in as little as 7 hours.⁷⁸ Button batteries within the auditory canal can lead to malignant otitis externa, tympanic membrane perforation, erosion of the external canal skin, hearing loss, and destruction of the ossicles.⁷⁹ Irrigation should be avoided, as it may hasten leakage of material and augment conduction of the battery's electrical current. In one review of 12 cases of button batteries within the nose, 5 patients required removal under general sedation, and 2 patients had residual septal perforation.⁴⁵

In the esophagus, button batteries constitute a true emergency, as they can cause esophageal injury in as little as 4 hours and transmural damage in as little as 6 hours.⁹ Mechanisms for injury are similar to those in the auditory canal. Button batteries tend to look like coins on radiographs, with the exception of a noticeable step off from the rim of the battery. In 2006, Silverberg and Tillotson reported a case in which 2 coins stacked together in a child's esophagus were mistaken for a button battery, given their appearance on radiograph.⁹ Emergent removal is the standard of care.

Magnets

Although toys with small magnetic parts are widely available, they pose a recognized danger to children, particularly when multiple magnets are ingested at once.⁸⁰⁻⁸² According to Morbidity And Mortality Weekly Report, 20 cases of magnet ingestion were reported to the Consumer Product Safety Commission from 2003 to 2006. Approximately 80% of patients were boys, with the mean age of 5.5 years.⁸² With the popularity of magnetic studs as a form of body decoration, case reports describing complications from accidental ingestion of the studs or adherence to the nasal septum have also been reported. Although small in size, these studs generate a powerful magnetic field because of their neodymium components.

Injury can also occur when 2 or more magnets attract each other across the nasal septum or across loops of bowel, leading to complications such as septal necrosis, septal perforation, bowel obstruction, fistulas, ulceration, volvulus, and perforation of the large and small bowel.^{81,83} Pressure necrosis from magnets adherent across the nasal septum can occur after only a few hours.⁸⁴ Assuming a single magnet was ingested can also lead to complications, if a second ingestion goes undetected.

Metallic instruments available in the ED often lack the grasping power to break the strong magnetic attraction between 2 adherent pieces and may even be repelled by the magnetic field around the objects.⁸⁵ In this situation, a clinician could use the opposite end of a metal instrument to adhere the object through magnetic attraction. A case report of this technique described introducing bayonet forceps "backwards" into the nasal cavity; upon withdrawal of the instrument, the magnet was also removed.⁸⁶ A nonferromagnetic hook may also be used to remove magnets from the nose. Alternatively, forceps can be used to hold a magnet steady in one nostril while another set of forceps is used to manipulate the second magnet off the septum.⁸⁷ Another technique involves using an ear curette to elevate one magnet off the septum and grasping it with alligator forceps. The second magnet is then easily removed, as the magnetic attraction to the other piece is gone.⁸⁸ One case report illustrated the use of a household magnet

to remove a nasal magnet when removal by both emergency clinicians and ENT specialists failed. This device was purchased from an auto supply store for less than US\$10.⁸⁹ If the septum has been injured, antibiotic ointment should be used on that area and the patient should then be evaluated by an ENT specialist within 1 to 2 weeks to ensure that appropriate healing is occurring.

Cyanoacrylate

The adhesive material known as cyanoacrylate may be used to remove foreign bodies, or it may inadvertently become a retained object. Its use in the management of foreign bodies in the auditory canal is limited to a single case report describing the placement of a small amount of the compound on a blunt plastic stick, which was then applied to the surface of the retained object. Once adhesion was complete after 30 to 60 seconds the object was removed from the ear canal.⁹⁰ A cadaver study compared the use of cyanoacrylate glue to right angle hooks for the removal of EAC foreign bodies and found that the median time for extraction was 6 seconds using the hook and 42 seconds using glue.⁹¹ Unfortunately, this method requires the patient to remain still for the entire process and is not generally recommended for use in the mobile pediatric population.

If cyanoacrylate glue has been placed into a body orifice, either accidentally or intentionally, hydrogen peroxide can be used to remove the concretion. In the same manner it is used to loosen cerumen, warm hydrogen peroxide (3%) can be instilled into the external canal and left for 10 to 15 minutes. If the glue cast is still adherent to the skin, a second application may be applied before an attempt is made to remove the glue by suction.⁹² In other orifices, gauze soaked in hydrogen peroxide may be used. Abadir et al described successful use of acetone in a case series involving 3 patients with accidental administration of cyanoacrylate glue into the ear canal.⁹³ The authors irrigated with sterile water after each procedure to limit tissue exposure to acetone. However, they acknowledged that the ototoxicity of acetone has not been well studied.

Live Insects

Insects and spiders account for 14% of foreign bodies in the ear, with cockroaches the most commonly encountered entity.⁹⁴ The management of live insects and spiders in this area can be particularly difficult for clinicians as well as patients, who usually present with severe distress from discomfort, tinnitus, and the knowledge that there is something alive in their ear. The goal is rapid inactivation of the insect, thereby allowing for quick and painless removal before complications such as tympanic membrane injury occur. In one bench-top study using a vari-

ety of chemical agents on several species of insects, ethanol (95%) and isopropyl alcohol (70%) killed the insects most rapidly, in less than 35 seconds on average.⁹⁴ However, these agents are no longer widely available in many EDs because of safety concerns about their flammability. Anesthetics such as lidocaine, cocaine, and tetracaine were also tested in this study. Although these reagents were effective in killing the insects, in most cases the effect onset was somewhat delayed, which may be unacceptable to many patients and their parents. Of the agents tested, a povidone-iodine solution and soapy water (1 tablespoon of detergent mixed in 100 mL of tap water) are most likely to be available in the ED or urgent care setting and to result in the desired effect in about 1 minute. If tympanic membrane perforation is visualized or suspected, none of these agents should be used. ENT referral is warranted in this situation. It should be noted that in this study, ticks were resistant to all agents used. In these cases, irrigation with warm water may dislodge the tick. If irrigation or manual attempts fail or if the tick is adherent to the external canal skin, referral to ENT for microscopy-assisted removal is recommended.

Esophageal Foreign Bodies

Bougienage for esophageal foreign bodies is currently being used in the ED. Observation periods are being considered. See the previous discussion of this on page 11. Hostetler and Bernard reported retrospectively on their use of ketamine to facilitate the removal of esophageal foreign bodies in the emergency department.⁷⁰ They found that despite reports of ketamine-associated laryngospasm in esophageal procedures, they had no significant problems in 57 patients. They reported that transient hypoxia was noted in 10.7% of patients treated with ketamine, glycopyrrolate, and midazolam, versus 15.4% in patients treated with fentanyl and midazolam. The length of stay with ketamine patients decreased from 5.7 to 3.7 hours when ketamine was used instead of fentanyl and midazolam.

Urinary Tract Foreign Bodies

Foreign bodies in the pediatric urinary tract are thought to be rare, and there is a paucity of supportive literature.⁵⁰ Objects may be self-inserted or iatrogenic (such as catheters), or they may migrate from adjacent organs (most commonly the GI tract).^{50,95} Children usually insert foreign bodies into the urinary tract out of curiosity; however, autoregression, psychiatric disease, child abuse, and attention-seeking behavior should also be considered.⁹⁵ Girls are more likely to have a foreign body in the urinary tract because of their short urethra. Objects are generally small, but in some parts of the world, leeches of significant size have been reported.⁹⁶ Recurrent or resistant urinary tract infections, hematuria, protei-

nuria, dysuria, or pollakiuria (abnormally frequent passage of relatively small quantities of urine) should raise suspicions of foreign bodies in the urinary tract. Significant complications include bladder perforation, urinary outflow obstruction, and sepsis.^{50,95}

The treatment of urinary tract foreign bodies involves removal of the object while minimizing trauma to the surrounding area. Analgesia, pain medication, and antibiotics are often required prior to removal. Unless the object is at the urethral meatus, urologic consultation is recommended for a transurethral cystoscopy with grasping forceps. If the object is in the bladder, an alternative solution is percutaneous suprapubic retrieval under direct visualization via cystoscopy.⁹⁵ Antibiotics are suggested if there is evidence of an active infection.

Sexual Abuse

In 2005, approximately 80,000 American children were sexually abused. A reported prevalence rate of 1.1% is likely low, given that 25% of adult women in one large study said they had a history of sexual abuse.⁹⁷ Both vaginal and rectal foreign bodies in pediatric patients should raise concerns about abuse. An evaluation by Merkley of 12 girls with vaginal foreign bodies indicated that 8 of them met the criteria for sexual abuse, while a study by Striegel et al of 24 girls under the age of 6 with vaginal discharge resistant to antibiotics or vaginal bleeding revealed that 17% had evidence of sexual abuse.^{26,29} Physicians must maintain a high index of suspicion in order to identify abuse. Red flags include a history of episodic vaginal bleeding and denial of a specific etiology. Physical examination findings may include laceration of the vagina, vaginal discharge, vaginal bleeding, and minor but definite alteration in the posterior hymenal rim.³⁷ The anus and rectum should also be inspected. Unfortunately, clinicians vary considerably in how they interpret histories and physical examination results with respect to possible sexual abuse. Nevertheless, any case of suspected abuse must be reported to the proper authorities.

Prevention Of Foreign Body Ingestion Or Insertion

Young children explore their environment with their mouth, but their immature swallowing mechanism and protective airway reflexes put them at risk for aspiration. Warning labels with age-suitability guidelines are now marked on the packaging of most toy products in Europe and North America. Introduction of these labels has resulted in a reduction in the number of toy-related foreign body injuries.⁹⁸ However, warning labels are not possible for every other possible foreign body a child can ingest or insert (ie, food products, beads, rocks, etc.).

Educating adults may be the most important method of preventing airway foreign bodies injuries. Data from the Susy Safe project show that in 49% of cases, foreign body injury occurred in the presence of a parent or caregiver.⁹⁹ A 2007 retrospective review of 197 medical records in Italy revealed that in 84.2% of cases, incidents resulting in airway foreign bodies occurred in the presence of an adult.¹⁰⁰ In general, making homes as child-resistant as possible by securing small objects, preventing toddlers from eating things that are frequently aspirated (eg, nuts), and exercising parental vigilance may prevent many episodes of foreign body ingestion or insertion into body orifices. Adults should be educated on the need for proper vigilance when a child is eating or playing. Screening the play area for small foreign bodies which may prevent many episodes of foreign body ingestion or insertion into body orifices is also necessary.

Disposition

External auditory canal and nasal cavity foreign bodies should be treated on a case-by-case basis. Patients with an aural foreign body that is spherical, smooth, or adjacent to the tympanic membrane should be referred to an otolaryngologist for extraction. Patients having significant trauma and epistaxis after nasal foreign body removal attempts should be referred to an ENT specialist. Referral should also be considered for patients who have undergone multiple failed attempts at removal prior to presentation in the ED, as soft tissue trauma and swelling may have occurred. Magnets and button batteries require emergent removal to prevent complications such as liquefactive necrosis. Consultation with appropriate specialties (ENT, GI, GYN) is required for any patient who will be receiving deep sedation, general anesthesia, or scope-assisted removal.¹⁰¹

Patients with vaginal foreign bodies can often be evaluated and treated in the ED or the outpatient setting unless serious complications require hospitalization. Patients who have undergone successful removal of rectal foreign bodies in the ED setting without any mucosal injury may be observed for a short period. If the extraction was complicated but without any mucosal damage, the patient may be observed for a longer period. Any serious complications present on initial evaluation or that are diagnosed after removal of the object(s) require gynecological or surgical consultation and hospitalization. With respect to rectal foreign bodies, if injuries sustained are felt to be more than superficial or if persistent rectal bleeding occurs, surgical consultation is warranted, and the patient should be admitted for further care and evaluation.⁷⁵

Patients with esophageal foreign bodies generally require endoscopic evaluation in the

emergency department. The exception would be coins which are in the lower esophagus which could be followed with radiographs to ensure passage into the stomach. If the foreign body has reached the stomach and is not particularly large or sharp, it can be managed on an outpatient basis with follow-up radiographs to ensure its passage out of the stomach. Beyond the stomach, sharp foreign bodies likely require surgical consultation as would obstructing objects. Otherwise, objects which have passed through the stomach will generally pass on their own and outpatient follow-up is recommended.

Patients with airway foreign bodies require immediate consultation with services capable of performing bronchoscopy for removal on an urgent basis.

Case Conclusions

Patient 1 had the wooden object removed from her nose using the parent's kiss positive pressure technique. Both mom and the child were comfortable with this procedure since no instrumentation was required.

After asking patient 2 and her mother about the vaginal itching, the patient recalls placing a bead in her vagina about a week ago. After a long discussion with the patient and her mother about a vaginotomy, you show the patient the instructions for the procedure. She tolerated the procedure well and you extracted a blue bead from the proximal portion of the patient's vagina while confirming there are no other foreign bodies.

Gastroenterology was consulted for patient 3. The patient remained stable without any difficulty breathing or other complaints. The consultant was tied up with an emergent situation at another hospital and reported she would not be available for a few hours. A repeat film was performed 4 hours after presentation showing the coin had migrated into the stomach. The patient's pediatrician was contacted and agreed to follow the patient as an outpatient.

References

Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study, such as the type of study and the number of patients in the study, will be included in bold type following the reference, where available.

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1. **Most coins pass through the digestive system without causing harm.**
 - a. True
 - b. False
2. **Which of the following statements is true regarding vaginal foreign bodies in children?**
 - a. Pediatric patients with vaginal foreign bodies always present with vaginal discharge.
 - b. In pediatric patients, symptoms of a vaginal foreign body always present shortly after insertion.
 - c. Vaginal foreign bodies in pediatric patients are easily diagnosed with noninvasive studies.
 - d. Vaginal foreign bodies in prepubertal girls are most commonly wads of toilet paper.
 - e. Vaginal foreign bodies in pediatric children never indicate child abuse.
3. **Vaginal irrigation or lavage with normal saline, warm water, or a povidone-iodine solution is well tolerated in females over the age of 6 and:**
 - a. Frequently requires sedation
 - b. Should be attempted even in an uncooperative patient
 - c. Is most effective after the object has been visualized on examination
 - d. Is easily accomplished in all patients
 - e. None of the above
4. **Which of the following statements is true regarding rectal foreign bodies in the pediatric population?**
 - a. Rectal foreign bodies are usually inserted for sexual stimulation.
 - b. Rectal foreign bodies are well studied and extensively reported in the literature.
 - c. Rectal foreign bodies most often result from ingestion, an iatrogenic cause, or impalement.
 - d. Rectal foreign bodies are similar to vaginal foreign bodies in that imaging studies often do not help in removal.
 - e. Rectal foreign bodies are usually easier to remove than vaginal foreign bodies.
5. **Which of the following statements is true regarding ED removal of rectal foreign bodies in children?**
 - a. Removal is simple and fast.
 - b. Removal can be done even if there is perforation.
 - c. Removal is easiest when the object is in the upper rectum.
 - d. Removal always requires a postextraction sigmoidoscopy.
 - e. Removal will likely require sedation and analgesia.
6. **Which of the following foreign bodies can be successfully removed from the auditory canal using irrigation?**
 - a. Button batteries
 - b. A cockroach
 - c. A piece of carrot
 - d. A magnet
 - e. Potato chips

7. A 4-year-old boy presents after ingestion of some coins he found underneath the couch. He is currently asymptomatic. Which of the following initial management scenarios is the most appropriate for this patient?
 - a. A barium swallow to determine the location of the object
 - b. Plain radiographs to determine the location of the object
 - c. Reassurance and discharge home with instructions to observe the child for complications
 - d. Referral to a gastroenterologist for endoscope-assisted removal
8. Which of the following external auditory canal foreign bodies should prompt a patient referral to an otolaryngologist?
 - a. Failed removal attempts at home by parents and at an urgent care center before presentation to the ED
 - b. Multiple small marbles
 - c. An object adjacent to the tympanic membrane
 - d. All of the above

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Target Audience: This enduring material is designed for emergency medicine physicians, physician assistants, nurse practitioners, and residents.

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Outside the U.S.: 1-678-366-7933
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5550 Triangle Parkway, Suite 150
Norcross, GA 30092
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EVIDENCE-BASED PRACTICE RECOMMENDATIONS

An Evidence-Based Review Of Pediatric Retained Foreign Bodies

Rempe B, Iskyan K, Aloï M. December 2009; Volume 6, Number 12

Children are incredibly curious about the openings in their bodies, and at the same time, they are fascinated by the many small objects they find in the world around them. This article reviews the management of retained foreign bodies in the ear, nasal cavity, aerodigestive tract, rectum, and vagina of pediatric patients. The goals of this review are to provide clinicians with a road map for managing cases of retained foreign bodies in their daily practice and to recommend instances when referral to an otolaryngologist, gastroenterologist, or other appropriate specialist is warranted. For a more detailed and systematic look at pediatric retained foreign bodies, see the full text article at www.ebmedicine.net.

Key Points	Comments
The probability of successful removal of a retained foreign body diminishes quickly with subsequent attempts.	Selection of the most appropriate removal technique and proper preparation of the patient will help to ensure that the first attempt is the best attempt. A review of 698 cases of foreign bodies in the external auditory canal indicated that the probability of successful removal decreased drastically after the first failed attempt, with the number of complications increasing with subsequent attempts. ⁴³
Never assume that only one foreign body is involved.	A postextraction examination should always be done to evaluate for damage and additional foreign bodies.
Cyanoacrylate glue may be useful for removal of objects within the nose or ear in specific situations, but the compound may also become a retained foreign body. Hydrogen peroxide is recommended for removal.	In the same manner it is used to loosen cerumen, warm hydrogen peroxide (3%) can be instilled into the external canal and left for 10 to 15 minutes. If the glue cast is still adherent to the skin, a second application may be applied before an attempt is made to remove the glue by suction. ⁹²
Some pediatric patients with an aerodigestive foreign body may present without a history of ingestion, whereas others may present with nonspecific symptoms such as irritability, upper respiratory infection symptoms, poor feeding, drooling, chest pain, trouble breathing, and coughing.	A substantial percentage of the pediatric population (between 7% and 35%) with a gastrointestinal foreign body may be asymptomatic after ingestion. ^{9,10}
Vaginal bleeding and discharge are the most common complaints in patients with a foreign body in this orifice.	Most vaginal foreign bodies can be diagnosed based on history and physical examination. If the suspicion for a vaginal foreign body is high but nothing is seen on physical examination, referral to a pediatric gynecologist is recommended.
Button batteries in the nose, ear, or esophagus require emergent removal. However, irrigation and introduction of anesthetic solutions are contraindicated in the removal of a retained button battery.	If they are available in the ED, magnets can be very efficacious in the removal of metallic objects such as ball bearings or button batteries from both the nares and the external auditory canal. ^{65,66}
Rectal foreign bodies should be suspected in children who present with rectal pain in the absence of a fissure or abscess on physical examination.	Rectal foreign bodies are most commonly due to ingestion. ³⁸ Because the period between ingestion of an object and appearance in the rectum can be up to 2 weeks, most children will not relate the rectal discomfort to a previous ingestion. ³³

See reverse side for reference citations.

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These references are excerpted from the original manuscript. For additional references and information on this topic, see the full text article at ebmedicine.net.

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