



VOICE DISORDERS

PEDIATRIC VOICE DISORDERS

Pediatric Voice Disorders: Highlights

Voice Disorders Do Occur in Children

- There are a variety of causes of hoarseness in children, the most common of which are not malignant or life threatening.
- There are some rare causes of hoarseness, however, that need immediate attention.

Voice Box Disorders in Newborns Are Quite Different From Those in Older Children and Adults

There are typical differences between hoarseness in newborns and children.

- Hoarseness or abnormal cry in newborns is usually caused by a congenital (present at birth) or neurologic (brain- or nerve-based) problem.
- Hoarseness in children is usually caused by a problem that occurs after birth. These causes include:
 - Vocal nodules
 - Infections
 - Papilloma
 - Gastropharyngeal reflux

Voice Box Disorder in Children Presents as Noisy Breathing (Stridor)

- Stridor (noisy breathing) in children is related to voice disorders because the cause(s) may lie within the voice box (laryngeal causes for noisy breathing).
- Stridor can also be caused by problems outside of the voice box.

Red Flag

- Noisy breathing (stridor) is a sign of obstruction or narrowing of the laryngeal or tracheal parts of the airway.
- Stridor is a sign of difficulty passing air.
- Any breathing difficulty needs immediate medical attention.

Pattern of Stridor Important to Determining Cause

- Stridor can occur only while breathing in (inhalation stridor), only while breathing out (exhalation stridor), or during both parts of the breathing cycle.
- Determining which part of the breathing cycle (inhalation or exhalation) is noisiest can help determine the cause of the stridor.

Voice Care Team for Children

An otolaryngologist who is familiar with pediatric voice disorders, often in conjunction with a speech language pathologist, should evaluate the child with hoarseness.

Understanding Pediatric Voice Disorders

In This Section

This section contains information on the following:

- Voice disorders in newborns
- Voice disorders in children

Voice Disorders in Newborns

In a newborn, an abnormal cry and/or noisy breathing (stridor) indicate problems in the voice box (larynx). Stridor may accompany potentially life-threatening conditions.

Red Flag

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What are the common causes of stridor in newborns?

Stridor = Noisy Breathing

- Anything that creates a blockage in the breathing passages causes turbulence in the passage of air, which then makes breathing noisy (stridor).
- Stridor can occur while breathing in, while breathing out, or during both phases of the breathing cycle.

Relationship of Stridor to Breathing Cycle	Most Likely Site of Problem
Stridor occurs only during inhalation	<ul style="list-style-type: none">• Above chest cavity• Outside chest cavity
Stridor occurs only during exhalation	<ul style="list-style-type: none">• Trachea and bronchi – within the chest cavity, <i>e.g., wheezing heard in asthma</i>
Stridor occurs during both inhalation and exhalation	<ul style="list-style-type: none">• Fixed narrowing in the trachea or voice box – <i>most commonly below the voice box (subglottis)</i>

Stridor Usually Worse With Increased Activity

- Stridor is most often seen when infants are awake and active or feeding.
- When the child is awake and active, increased rates of breathing often exacerbate the turbulent airflow and noisiness.

Stridor Present Only During Sleep Indicates Partial Blockage

- Occasionally, children are noisy breathers when sleeping.

- This is a sign of a partial airway obstruction that worsens when the **hypopharynx** and **larynx** relax.
- Any obstruction(s) in the upper part of the airway should be investigated.

Paradoxical Stridor

- Noisy breathing that only occurs during feeding or sleep and that resolves during crying is a sign of blockage in the nasal cavity.
- This is called paradoxical stridor because the infant breathes better when active or agitated rather than when quiet.

i Key Information

Obligate Nose-Breathers

- Infants are obligate nasal breathers (breathe through the nose only; do not know how to breathe through the mouth) until about the age of three to four months.
- Any blockage in the nose and nose cavity can cause significant noisiness – even gasping – in a newborn.

Effects on Feeding

- Any child with persistent progressive noisy breathing should be evaluated by a practitioner familiar with breathing disorders in children. Often, no therapy is required. However, the child should be followed closely to be certain that he or she grows and gains weight properly.
- The very young must learn quickly to coordinate the suck-swallow-breathe cycle. Minor changes in this cycle due to airway obstruction may interrupt their ability to feed. Failure to thrive or grow is an important indicator of the severity of their breathing disorder.

Laryngomalacia – Floppy Larynx or Voice Box

- Laryngomalacia, or "floppy larynx," is a very common cause of noisy breathing in children.
- Typically, these children develop noisy breathing during inhalation within weeks of birth. The noise they make is a high-pitched squeak on inhalation that worsens with activity such as crying or feeding.
- Floppy larynx is caused by collapse of the epiglottis and other structures above the vocal folds during inspiration. The exact cause of the collapse is unknown. (*For more information, see Anatomy & Physiology of Voice Production.*)

Diagnosis

The diagnosis of laryngomalacia is made by history and physical examination. The physical examination includes visualization of the upper airway during breathing to confirm the diagnosis.

Role of Specialized Viewing Examinations

In some cases further examinations, such as x-rays of the neck and chest, may be required. A more detailed viewing of the throat and voice box area (**laryngoscopy**), esophagus (**esophagoscopy**), and trachea and bronchi (**bronchoscopy**) might also be required.

Floppiness Is Transient

The floppiness of the larynx is transient and typically resolves during the first year of life. If the child is able to gain weight and grow at expected rates, no treatment is required. Frequent assessment of weight gain should be taken for this purpose.

Surgical Correction May Be Necessary in Severe Cases

Although rare, severe cases of laryngomalacia may need surgical correction of the floppy parts of the larynx to provide an adequate airway.

- **Microlaryngeal Surgery:** Specialized surgery, performed with microsurgical tools and through a surgical microscope (microlaryngeal surgery), may be required in severe cases to relieve the obstruction and allow the infant to coordinate the

breathing and swallowing cycles. The surgery aims to carefully remove the floppy parts of the larynx that collapse into the voice box inlet (laryngeal inlet) while making sure that voice function remains intact.

Laryngomalacia Is Affected by Reflux (Backflow of Stomach Fluids to the Throat and Voice Box)

Often, treatment for **laryngopharyngeal reflux** is instituted in children with laryngomalacia. (*For more information, see adult Reflux Laryngitis.*) Laryngopharyngeal reflux is often seen in infants with laryngomalacia for several reasons.

- With the increase in the "work" of breathing, air is often swallowed during feeding, causing distention of the stomach. This then makes it easier for stomach fluids to backflow toward the food pipe (**esophagus**), eventually reaching the lower throat (hypopharynx) and voice box (larynx).
- With the floppy larynx collapsing during inhalation, efforts to breathe can result in a lower pressure in the chest. This makes it easier for stomach fluids to backflow toward the food pipe, lower throat, and voice box.
- Edema (swelling) from reflux creates a narrower breathing passage, which exacerbates the laryngomalacia.

What causes abnormal cry in newborns?

An abnormal cry in newborns has many possible causes. They can be broadly grouped into congenital or neurologic causes.

Congenital Causes

Laryngeal Web – Web of Tissue Remaining Between Vocal Folds

- **Description:** The vocal folds are supposed to separate during development. Rarely, this separation does not occur and a web of tissue is left across the laryngeal inlet. This is called a laryngeal web or glottic web.
- **Effects on breathing:** Breathing is possible because the back portion of the larynx, where the arytenoids cartilage attaches to the vibrating part of the vocal fold, is usually not associated with the web. The child's cry may be characterized as weak. Occasionally, stridor also results from the mild narrowing of the glottic inlet.
- **Diagnosis:** Generally, children with laryngeal webs are not diagnosed until after the first or second year of life. The diagnosis is made by diagnostic endoscopy. Radiograms may also be helpful to determine the length of the web. A lateral neck radiograph may show the classic "sail" sign.
- **Treatment:** Surgical correction usually entails expansion of the subglottic cartilage as well as lysis of the web across the membranous vocal fold.

Congenital Cysts – Laryngoceles

- **Description:** Congenital cysts are mucus-filled sacs that develop on the vocal folds. Cysts usually result in abnormal cry.
- **Effects on breathing:** Children with congenital cysts may also develop some problems with breathing.
- **Diagnosis:** Diagnosis is usually possible with diagnostic endoscopy.
- **Treatment:** Surgical excision of the cysts is necessary, as they will generally enlarge as the sacs fill with mucus. Endoscopic approaches through the mouth as well as external approaches through the neck are possible. The recommended technique depends on the situation of the individual child.

Hemangiomas – Blood Vessel Tumor

- **Description:** Hemangiomas are benign tumors made up of blood vessels (**capillaries**) that uncontrollably increase in number. When hemangiomas occur on the vocal folds or in the area underneath the voice box, hoarse cry and/or noisy breathing usually result.
- **Typical Behavior of Hemangiomas:**
 - **Begins to grow in the first months of life:** Generally, the tumor begins to grow within the first weeks to months of life and may be associated with other vascular birthmarks.
 - **Enlarges, then shrinks:** The tumor usually will begin to shrink or regress after the first year of life. The timetable for shrinking/regression is not predictable, however.

Even if it becomes large, it is not cancerous: Although they increase in size and can become large, hemangiomas are not cancerous (**malignant**).

- **Treatment:** Treatment varies depending on the size, location, and progression of the hemangioma. Physicians and patients must balance the need to intervene with waiting, since hemangiomas eventually shrink. In particular, treatment plans must be made cautiously to prevent any damage to structures in the voice box (larynx) or the area underneath the voice box (**subglottis**).

Red Flag

Very Large Hemangiomas Can Cause Problems Related to Breathing, Heart Function, and Bleeding Control

- **Breathing difficulties:** The size of the hemangioma can block the airway passage, making it difficult to breathe.
- **Heart workload increased:** The heart has to work harder in order to circulate the blood in the hemangioma and throughout the body.
- **Imbalances in the control of bleeding:** The hemangioma can cause an imbalance in the different cells and substances involved in the control of bleeding, to the point that a bleeding disorder can result.

Key Information

Airway problems can occur. When airway problems do occur, there are some surgical techniques that can be used **to try to avoid** a tracheostomy when airway **obstruction** and breathing problems become evident.

Neurological Causes

Neurological causes of hoarseness in newborns are generally related to paralysis of one or both of the vocal folds.

Paralysis of Both Vocal Folds

- **Description:** Bilateral vocal fold paralysis causes more breathing problems than voice problems. Although the cry may be a little weak and breathy, noisy breathing is more evident.
- **Reason for the breathing problems:** Normal laryngeal nerves and muscles move the vocal folds to the closed position during crying, sound production (newborn), or speech/singing (older children and adults), and move the vocal folds apart during breathing. Two-sided vocal fold paralysis makes this impossible. The vocal folds stay close together during inhalation, causing a high-pitched, squeaky noise.
- **Diagnosis:**
 - **Two-sided paralysis may look similar to laryngomalacia.** Since the vocal folds are paralyzed in approximation, the voice may sound relatively normal and can fool even the experienced practitioner. Diagnosis relies on diagnostic endoscopy.
 - The vocal folds may have the appearance of motion but it will be paradoxical, moving in during inhalation (instead of opening) and out during exhalation. This is due to the movement of the air in and out of the windpipe (trachea) during breathing.
 - Once diagnosed, the cause of the paralysis should be investigated. Often, no specific cause can be found. The cause may be related to some birth trauma that has pinched the nerves to the larynx. In some cases, the problem might be in the brain or in the base of the skull; these cases require specialized tests in consultation with a medical brain-nerve specialist (**neurologist**).
- **Treatment:** Regardless of the cause, a little more than half of newborns with vocal fold paralysis require a breathing tube placed directly in the windpipe (**tracheostomy**) below the voice box where the paralyzed vocal folds are located. When these children have grown and vocal fold motion has not returned in two or three years, other surgical procedures are possible to widen the airway and remove the tracheotomy tube.

One-Sided Vocal Fold Paralysis

- **Description:** Paralysis of only one vocal fold will result in a very weak and breathy cry. Generally, no breathing or

swallowing problems will occur. Children are often capable of overcoming the lack of motion of one vocal fold, and their voice will perform very well in the long run. Infrequently, problems will occur with swallowing due to aspiration.

- **Diagnosis:** Determining the cause of the paralysis is important. As with bilateral vocal fold paralysis, the actual cause may never be known, but tumors along the path of the laryngeal nerve or impingement of the nerve by other structures should be ruled out.
 - **Treatment:** Procedures to bring the vocal folds closer together, while keeping them far enough apart to allow good breathing, are possible. The larynx in children grows, however, and the correction may become inadequate over time.
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Voice Disorders in Children

Voice disorders in children are usually described as "hoarseness." Hoarseness is a rough character or quality of the voice that may make it more difficult to be heard and understood. Hoarseness may be associated with intermittent complete loss of voice, typically after extensive use (i.e., at the end of the school day).

Hoarseness in Children Is Very Common

Hoarseness is actually very common in children and is usually caused by abnormalities of the vocal folds. It can cause significant psychosocial and academic problems. Children are often teased and ostracized for things that make them different from their peers. Performance in school can also be hampered if students are unable to comfortably express themselves verbally.

Red Flag

- An estimated million-plus children nationwide suffer from voice disorders.
- Many of these children are not given the medical evaluation or attention they need to help them achieve improved voice function.

Most Voice Disorders Benign

Fortunately, most hoarse children have benign and often easily treated laryngeal disorders causing their voice disturbance.

Rarely, Voice Disorder Can Be Caused by a Life-Threatening Condition

Hoarseness that persists for months or progresses with time needs to be evaluated to exclude the possibility of a life-threatening condition.

- Medical evaluation is best done in conjunction with a speech language pathologist.
- A complete history and physical examination is necessary.
- Visualization of the larynx is often required to determine the exact cause of the hoarseness.

What are the causes of hoarseness in children?

Inflammation

Inflammation of the vocal folds is a very common cause of hoarseness in children. The two main causes of inflammation are:

Viral Infections

- Viral infections that cause upper respiratory tract infections usually also cause swelling of the voice box or larynx. This is probably the most common cause of hoarseness in children.
- Typically, a viral upper respiratory tract infection is followed by hoarseness.
- It is unusual to have breathing or swallowing problems related to the infection, and the hoarseness is usually short-lived.

Laryngopharyngeal Reflux (LPR)

- Inflammation of the voice box due to the backflow of stomach fluids into the larynx is another common cause of hoarseness in children.
- LPR has been well recognized in adults but not in children. In children, the diagnosis of reflux-induced laryngitis is not easy to make with objective measures.
- As in adults, a trial of reflux therapy without an absolute diagnosis of gastroesophageal reflux is often necessary. If the hoarseness or inflammation seen on the larynx improves while the reflux is treated, reflux laryngitis can be inferred. However, it is difficult to confirm that adequate anti-reflux treatment has been achieved.
- In the studies that have been performed in adults, more aggressive treatment than typical for the treatment of heartburn-type reflux or gastroesophageal reflux (GERD) was required to resolve hoarseness.

Nodules

Nodules on the vocal folds, also known as "screamer's nodules," are another very common cause of hoarseness in children. Typically, young boys who use their voices aggressively during play develop a thickening along the surface of each vocal fold at the junction of the middle one-third and front one-third. Children who are not necessarily aggressive or abusive with their voices may also develop these thickenings.

Probable Cause(s)

The actual cause of the nodules is unknown. The leading causes thought to induce the inflammation that leads to nodule formation are voice abuse or inflammation from reflux of gastric contents.

Diagnosis

Diagnosis is made by visualizing the vocal folds and identifying benign thickening on the vocal folds.

Treatment

The first lines of treatment are voice therapy and perhaps treatment for gastroesophageal reflux (with either behavioral management to decrease the likelihood of reflux or medications to decrease the caustic nature of the contents refluxed). Generally, nodules decrease in size and symptoms as the child ages. As the voice deepens and the vocal fold lengthens, the nodules generally improve. Again, the exact reason for this development is poorly understood but is most likely due to changes in the vibrating structures of the vocal fold as it lengthens with age.

Voice Therapy

- **Correct Diagnosis Critical:** Nodules respond to voice therapy, while cysts and polyps do not.
Lesions of the vocal folds can be misdiagnosed as vocal nodules and may in fact be a vocal fold polyp or cyst. Vocal fold polyps and cysts do not improve with voice therapy and thus may require surgical excision at the appropriate time in the child's maturity-development time line. If a patient is able to tolerate videostroboscopy, a confident diagnosis of vocal fold nodules versus other vocal fold lesions can be made.
- **Decision for Voice Therapy Complex:** Once the diagnosis of vocal nodules has been confidently made, the decision for proceeding with voice therapy is a complex decision based on a number of factors.
severity of the child's voice problem (frequency of voice loss, amount of negative attention due to hoarseness, negative social pressure in the classroom, etc.)
child's maturity
child's personal interest in improving voice
- **Motivation of Child Critical to Success of Therapy:**
Voice therapy is a treatment that needs to be taught and then carried over into the child's daily life. Concepts taught in voice therapy can be supplemented and reinforced by the parents, but the primary motivation for improving the voice must stem from the child or voice therapy will be unsuccessful. Thus, the maturity of the child is essential in deciding whether voice therapy should be used.
After the diagnosis of vocal fold nodules have been made in a young child, it is often best to wait before beginning

voice therapy treatment until the child notes a functional limitation with the voice and is appropriately mature and motivated to comply with the recommendations and teachings that occur during voice therapy.

Surgical Treatment

- Infrequently, a child may continue to have significant hoarseness despite mastering the voice therapy required for good voice use and receiving adequate treatment for reflux. These children may benefit from removal of the thickened portion of the vocal fold. This may make sound production easier by decreasing the mass of the vibrating vocal fold.
- Care must be taken, however, not to damage the underlying structures of the vocal fold, which could cause permanent scarring and perhaps lifelong hoarseness. New techniques for removing the superficial nodular thickening without damaging the underlying support structure of the vocal fold are being created.

Vocal Fold Cysts

- Cysts in the vocal fold are uncommon but may be mistaken for vocal nodules. It is important to try to discern between the two because cysts of the vocal fold (intracordal cysts) generally do not resolve without surgical intervention.
- Voice therapy may help to improve the voice but removal of the cyst is often required.
- At times the only way to correctly distinguish between the two is during direct laryngoscopy. Under a general anesthetic, the vocal folds can be palpated to determine if the thickening is from a nodule or a cyst.

Recurrent Respiratory Papillomatosis (RRP)

- RRP is caused by a viral infection by the human papilloma virus (HPV). Viral infection with HPV results in small wart-like growths (papillomas) on the vocal folds.
- Vocal fold growths can cause hoarseness. They can also cause significant breathing problems if they become bulky and obstruct the breathing passage.
- There are currently no good medical treatments for the viral papilloma. Several anti-viral medications are being investigated, however.
- Typically, the growths require physical removal either with a laser, cold steel micro instruments, or with a laryngeal debrider instrument.
- Some immunological changes occur as a child ages, which may bring the viral infection under control. Until that time, the treatment standard is periodic removal of the papillomas to maintain the breathing passage without irreversibly scarring the larynx.

(For more information, see Recurrent Respiratory Papillomatosis.)

Tumors

- Tumors of the larynx are extremely rare but should be considered in any child with persistent or progressive hoarseness.
- Visualization of the larynx is the best way to determine the presence or absence of a tumor of the larynx.
- If a tumor is present, biopsy is often required for diagnosis before a definitive treatment plan can be established.

Endotracheal Tube Complications

- Placement of a tube through the larynx (endotracheal intubation) to help with breathing either during surgery or for other major illnesses may damage the voice box, causing hoarseness.
- Injuries may include:
 - Paresis of the vocal fold
 - Dislocation of the arytenoid cartilage of the vocal fold

Narrowing from scar formation in the area just under the vocal folds (subglottis)

- Hoarseness that persists after endotracheal tube placement should be evaluated and will likely require visualization of the larynx either in the office and/or operating room.
- Depending on the nature and cause of hoarseness, treatment is possible.

Congenital Abnormalities

- Congenital abnormalities of the larynx can cause hoarseness in older children. These abnormalities may also cause breathing troubles and often present in the very young.
- **Laryngeal web:** Occasionally a web across the front portion of the larynx (laryngeal web) may not cause breathing problems but can cause hoarseness. The diagnosis of a laryngeal web relies on visualization of the voice box. The web at times may be divided through the mouth with endoscopic techniques but often requires dividing the subglottis as well with an incision through the neck. This procedure allows enlargement of the cricoid ring, if it is affected.

Symptoms of Pediatric Voice Disorders

What are the symptoms of voice disorders in children?

Many symptoms are common among the disorders that cause hoarseness, but some are more specific to the individual cause.

Laryngopharyngeal Reflux (LPR)

Laryngopharyngeal reflux often causes hoarseness that is worse in morning. LPR may be associated with a sour taste in the mouth or bad breath. Symptoms of heartburn are often not present. Nocturnal cough may or may not be present. Hoarseness may fluctuate over time as the reflux events come and go.

Nodules and Cysts

Although all forms of hoarseness will worsen with overuse, nodules and cysts typically worsen at the end of the day or during times of high use. Severe straining to initiate voicing (aphonia) can be common. A harsh or aggressive attack required to initiate speech is typical, caused by the increased mass on the vibrating fold.

Papillomas

Papillomas generally cause a progressive, ever-worsening hoarseness that leads either to aphonia or respiratory distress. Although fluctuations may be seen with use, there is a general trend toward a worsening voice. Sometimes snoring is also associated with the enlarging papillomas. If snoring worsens or breathing difficulty is encountered in patients with papillomas, medical attention should be promptly sought.

Laryngeal Web

Congenital laryngeal webs generally do not vary in terms of the hoarseness observed. A child may have a persistent weakness or quietness to the voice that has been present since birth.

Vocal Fold Scarring

Scarring from airway manipulation usually peaks 4-6 weeks after the incident. Slow, progressive worsening of voice and breathing may accelerate at the end of the this time period as the airway narrows. This timing of events would be typical for voice disorders caused by intubation.

Vocal Fold Tumors

Neoplasms or tumors of the larynx act similarly to papilloma. As they grow there may be progressive worsening of the voice, perhaps leading to breathing difficulty or stridor.

Red Flag

- Noisy breathing (stridor) is a sign of obstruction or narrowing of the laryngeal or tracheal parts of the airway.
- Stridor is a sign of difficulty passing air.
- Any breathing difficulty needs immediate medical attention.

Diagnosis of Pediatric Voice Disorders

How are voice problems in children evaluated or diagnosed?

Typical History Features

Typically, hoarseness in children is present for a long period of time. Often, family members do not notice the rough quality of the child's voice until someone like a teacher, friend, or doctor points it out to them. Once this hoarseness is identified, often the family cannot remember a time when the child did not sound that way.

- **Voice quality varies:** Vocal quality may also come and go depending on the use of the voice. During times of high use, the voice will worsen and tire. The child may have to strain to have any voice at all and at times may not be able to make appreciable sound. With rest, the voice usually returns, but may remain strained.
- **Special challenges in the child-patient:** Symptoms of reflux are very difficult to elicit in children. Children may not know what reflux is. They may experience reflux and not know that it is abnormal. Finally, reflux to the level of the larynx does not have to happen very frequently to cause significant problems in the larynx, according to adult research.

Questions such as, "Do you ever feel like you throw up but it doesn't come all the way up and you swallow it?" or "Do you ever have wet smelly burps?" may help identify children who are refluxing.

Physical Examination

The physical exam is often normal in children with voice disorders. It is not until the larynx is visualized that the abnormality is seen.

- If there are breathing problems associated with hoarseness, plain radiographs of the neck and the chest help physicians see the area just below the vocal folds, the subglottis, and the trachea.
- A direct examination of the voice box or larynx is necessary for diagnosis or treatment. The larynx can be seen with a flexible telescope through the nose or with a rigid telescope through the mouth. The structures of the larynx are seen and evaluated. Movement of the vocal folds, the vibration pattern of the vocal folds using stroboscopic lighting, and the anatomy of the surrounding structures are also evaluated. (*For more information, see Laryngoscopy/Stroboscopy.*)
- Direct laryngoscopy requires a general anesthetic to allow the larynx to be seen close up and palpated. After a safe general anesthetic is achieved, laryngoscopes can be passed through the mouth to expose the larynx directly. A magnified view of the structures of the larynx can be seen with telescopes and microscopes. Microlaryngeal instruments can be used to manipulate the fine structures of the larynx to determine the cause of the hoarseness. There may be a mild sore throat but generally there is no significant discomfort after this examination.
- **Role of the speech language pathologist:** The speech language pathologist is an integral part of the team that evaluates hoarseness in children. These clinicians subjectively assess the voice. They also have voice recording machines that can be used to help analyze the quality of the voice and document changes during treatment.

What should parents and/or children expect for each evaluation?

For children and adults, going to the doctor is often an anxiety-evoking experience. For children, most well-child checks include vaccinations. Mentioning a trip to the doctor is usually associated with the pain of a shot.

A trip to the otolaryngologist and speech language pathologist may also be frightening to the child. During the visit, the child and parent will be asked questions and then the child will be examined. The examination will include many familiar things like looking in the ears, nose, and throat and feeling the neck. Some radiographs (x-rays) may be taken and this will be just like getting a picture taken.

The otolaryngologist may also decide to look at the voice box or vocal folds. This can be done in a couple of different ways, and it really depends on the child which way will be best.

Rigid Laryngoscopy and Stroboscopy

- One examination uses a camera attached to a shiny tube with a bright light. With the child's tongue sticking out, the physician inserts a tube inside the mouth and looks straight down at the vocal folds. It is then possible to videotape the vocal folds opening and closing during breathing and speaking.
- A light flashing at nearly the same frequency of the vocal folds is also used so the vibration of the vocal folds can be examined (stroboscopy). This technique allows the examination of the vibration function of the vocal folds, which is critical to voice production.
- The telescopes used in stroboscopy can be used in children who are older than five or six. Some patients cannot tolerate the camera in their mouth, because it causes them to gag. Panting can help, but occasionally it is impossible to complete the examination.

(For more information, see Laryngoscopy/Stroboscopy.)

Flexible Laryngoscopy and Stroboscopy

- In cases when the rigid telescope cannot be used inside the mouth to look at the larynx, a flexible telescope can be inserted through the nose to look at the voice box. This can be used in children under age 5 and anyone else who cannot tolerate examination through the mouth. Often a topical anesthetic and decongestant are sprayed in the nose. This makes the mucosa in the nose shrink to facilitate insertion of the telescope and also numbs the nose so that the procedure is less uncomfortable.
- The lighted flexible telescope is steered through the largest passages of the nose to the back of the throat where the voice box can be seen. Videotaping and stroboscopic evaluations are possible.
- The discomfort experienced during this procedure is due to the fact that something is deep inside the nose, while our reflex is to keep things out of the nose. Once the scope is in proper position, most children tolerate the procedure very well.
- **A note on crying:** Crying does not inhibit the otolaryngologist's and speech language pathologist's ability to complete the examination successfully. No one likes to make children cry, but it is important to have a good look at the vocal folds as well as their motion and vibratory characteristics. Sedation for this procedure is not possible as it would blunt the child's ability to follow directions and speak during specific parts of the examination.

(For more information, see Laryngoscopy/Stroboscopy.)

Coaching Before a Procedure

Different children require different coaching from the parent prior to the visit. Some do best without any preparation. Others benefit from being told that they are going to the doctor to help them with their voice. The doctor may make a movie of their voice box with a camera.

Key Information

Evaluation of Voice Disorders Needs to Be Carefully Done

- A trained otolaryngologist should evaluate voice disorders in children (abnormal cry or hoarseness with or without noisy breathing). Evaluation in a Voice Center is ideal, especially in complex cases.
- Visualization of the voice box or larynx is critical to the diagnosis of voice disorders, and should be done with the right equipment.
- Nodules of the vocal fold will be the most common diagnosis for pediatric voice disorders, but the other rare causes of hoarseness must be ruled out by visualizing the vocal folds.

Red Flag

Especially in hard-to-manage children, voice disorder must not be diagnosed as a psychiatric or psychological problem unless voice specialists evaluate the voice box and voice function.

Treatment of Pediatric Voice Disorders

How are pediatric voice disorders treated?

Treatment Depends on Diagnosis

Hoarseness is typically caused by irritation and swelling of the vocal folds. Successful treatment requires the removal of the irritating condition.

- If irritation is caused by backflow of stomach fluids to the throat and voice box (**laryngopharyngeal reflux**), the LPR should be treated.
- If irritation is from vocal abuse, tips to avoid abusing the voice are given.
- If irritation is from postnasal drip, interventions to clear the nose are done.
- If irritation is from small growths like papilloma or cysts, they are surgically removed.

Often, however, the exact irritating cause of the hoarseness cannot be identified. If that is the case, a treatment plan is formulated with the consensus of the voice care team (otolaryngologist, speech language pathologist) and the family. (*For more information, see Voice Care Team.*)

Speech Therapy Is the Current Mainstay for Treatment

- Speech therapy is generally helpful in all conditions. It can be especially helpful in children who use their voice aggressively or who are required to use a harsh aggressive attack with their voice because of their hoarseness.
- Techniques to encourage a comfortable initiation of voicing are taught to the child. The parents are also taught so that they can help the child practice at home.
- The child must use the techniques outside of the therapy sessions if success is to be achieved. Alternatives to rough play noises are sought. Techniques for translating comfortable voice to comfortable yelling or projecting are also taught to children who play sports or who have to be heard over noise.

Gastroesophageal Reflux Can Be Treated Medically and/or with Behavioral Modification

- Behavioral modifications include avoiding reclining with a full stomach, eating shortly before sleep, or eating fatty, acidic, or spicy foods.
- Caffeine and nicotine promote relaxation of the lower esophageal sphincter and should be avoided. Many carbonated beverages are loaded with caffeine.
- Depending on the severity of the reflux, the otolaryngologist may prescribe medication to help neutralize the secretions of the stomach. A consultation with a gastroenterologist may also be necessary.

Structural Problems of the Larynx May Need Surgical Correction

- Cysts in the vocal folds are usually removed, preserving the vibrating portions of the vocal folds while avoiding scarring.
- Papillomas are debulked to alleviate blockage of the breathing passages while avoiding permanent damage to the vocal folds during their removal.
- Occasionally, children continue to have vocal nodules despite mastery of voice therapy and successful treatment of all other causes of vocal fold irritation. These children may benefit from careful removal of the nodular thickening to give them a smooth vocal fold surface. Equalizing the mass and balancing the vibratory character of both vocal folds can make it easier for the initiation and maintenance of voice production. Extreme care must be taken not to disturb the deeper structures of the vocal folds and thus prevent scarring. Children who cannot master good voice use or who continue to have irritation of the vocal folds from other sources like reflux are likely to have recurrence of their vocal nodules. Surgery should be avoided in these children to prevent permanent worsening of the voice.

What is the frequency of treatment success?

An Outlook on Treatment

Nearly every child's voice can improve with treatment. There may be some residual hoarseness or fluctuations in the quality of the voice, but almost all patients improve.

Combination of Treatment Strategies Key to Success

The key is to find the right combination of treatment strategies that maximizes the voice condition at minimal risk. The degree of difficulty to maintain "best voice" should also be assessed.

Balancing Voice Therapy and Surgical Risk

Although rare, there are some situations when a normal voice can be reached through strict voice therapy and rigorous behavior changes at the expense of quality of life. It may be worthwhile accepting the risk of some surgical treatment in these situations to ease the burden required to maintain a decent voice.

Collaboration of Parents and Voice Care Team

Both the family and the voice care team should discuss the expectations and final result desired prior to any treatment. Everyone should agree on the goals and expected treatment outcomes before any treatment is initiated.

What is new in the treatment of pediatric voice disorders?

Advances in the treatment of voice disorders in children are progressing on multiple fronts.

- New instruments to visualize the larynx in children are being introduced as technology enables the miniaturization of various instruments.
- Voice analysis instruments are also being calibrated for use in children.
- Normative data on growing children is not yet available but is being collected.
- Surgical techniques used in adults are being adjusted for the pediatric larynx.
- Investigators are continuing to learn about the vocal folds and the substances that compose them. The extracellular matrix and the ultrastructure of the pediatric larynx are known to change with age. It is unclear whether this can be used to our advantage or if this makes surgical interventions of the pediatric larynx more hazardous.
- Advances in microlaryngeal surgery techniques continue to improve our ability to safely correct anatomical problems of the pediatric larynx.

 **Advisory Note**

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