



VOICE DISORDERS

# VOCAL FOLD PARESIS / PARALYSIS

# Vocal Fold Paresis/Paralysis: Highlights

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## In Brief

Partial (**paresis**) or complete loss (**paralysis**) of nerve function to voice box muscles results in abnormal vocal fold function, affects the ability to speak and sing and, in some cases, also breathe and swallow. Attempts to compensate for loss of muscle function, often leads to voice tiring after prolonged use (**vocal fatigue**).

## Temporary or Permanent

Interruption of the nerve input to voice box muscles may be temporary or permanent, partial or complete, and may affect one or more voice box muscles.

## A Continuum

Vocal fold paresis and paralysis comprise a range - from mild to severe - of abnormal voice box muscle functions due to varying degrees of abnormal nerve input.

## Paresis

### A Frequently Missed Cause of Voice Disorders

Paresis of voice box muscles is often missed as the cause of a voice disorder because patient complaints can be very mild. For example, a patient with vocal fold paresis may only notice voice tiring after use, often at the end of the day (**vocal fatigue**).

### Identification of Paresis and Paralysis Needs to Be Carefully Done

- Absence of vocal fold movement (**vocal fold immobility**) is highly suggestive of vocal fold paralysis but may also be due to other causes - hence thorough medical evaluation is necessary.
- Likewise, if the vocal folds do move, it does not eliminate nerve impairment as a cause of the voice disorder since vocal fold paresis may be present.

### Two Key Tests Used to Identify Paresis and Paralysis

- Magnified viewing of vocal movement and position through a special scope (**laryngoscopy**) can identify vocal fold abnormalities suggestive of vocal fold paralysis. (*For more information, see Laryngoscopy/Stroboscopy.*)
- **Laryngeal electromyography** or LEMG confirms the diagnosis of vocal fold paralysis or vocal fold paresis. (*For more information, see LEMG.*)

## Identification of Cause

### Cause Is Key to Treatment Plan

Since there are many causes of vocal fold paresis and paralysis, the cause for each patient needs to be evaluated systematically. As with all disorders, finding out the cause helps map out a treatment plan.

## Voice Treatment

### Treatment Goal

Even when nothing can be done about the nerve damage causing vocal fold paresis or paralysis, improving the function of the vocal fold and voice can be addressed by the voice box surgeon-specialist (laryngologist).

 **Red Flag**

Any and all airway problems require immediate attention.


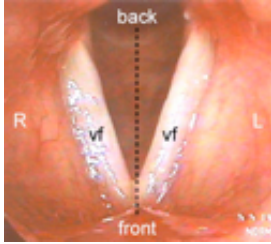
# Understanding Vocal Fold Paresis/Paralysis

## What are vocal fold paresis and paralysis?

Vocal fold **paresis** and **paralysis** comprise a continuum of abnormal nerve inputs to the voice box muscles (laryngeal muscles) – ranging from the loss of some to all neural input.

- Paralysis is due to the total interruption of nerve impulse resulting in no movement of the muscle.
- Paresis is the partial interruption of nerve impulse resulting in weak or abnormal motion of laryngeal muscle(s).

## Vocal Fold Paralysis Versus Normal Vocal Folds – Open Position

| One-Sided Vocal Fold Paralysis   | Normal Vocal Folds  |
|--|---|
|  <p>Paralyzed left vocal fold (*vf) is foreshortened and appears "fatter" due to loss of muscle tone; the surrounding areas (indicated by yellow arrows) are also affected and seem to "collapse" onto the vocal folds in contrast to normal vocal folds.</p> |  <p>Normal vocal folds on inspiration (open); note right and left vocal folds open equally from the imaginary midline [-----].</p> |

### **i** Key Information

Viewed with patient facing examiner: vf, vocal folds; R, right side of patient; L, left side of patient

## What nerves are involved in vocal fold paresis/paralysis?

Like all other voluntary movements of the body, vocal fold movements are a result of the coordinated contraction of various muscles. These muscles are controlled by the brain through a specific set of nerves. Brain signals responsible for movement (**motor signals**) intended for the voice box travel through the tenth cranial nerve or **vagus nerve**.

Each side of the voice box receives its own set of signals from the brain through two named nerves.

1. **Superior laryngeal nerve (SLN):** Carries signals to the voice box muscle that is between the cricoid and thyroid cartilages of the voice box, hence the name, cricothyroid muscle. (*For more information, see Anatomy & Physiology of Voice Production.*)

Since the cricothyroid muscle is involved in adjusting the tension of the vocal fold for high notes during singing, SLN paresis and paralysis result in:

- a. Abnormalities in how high or low the voice is (**pitch**)
- b. Inability to sing with smooth change to each higher note (glissando or pitch glide)

Because the other voice box muscles are still active, the vocal folds may still appear to move normally. This may make the diagnosis of SLN paresis/paralysis difficult in some cases. Sometimes, patients with SLN paresis/paralysis may have a normal speaking voice but an abnormal singing voice.

2. **Recurrent laryngeal nerve (RLN):** Carries signals to different voice box muscles responsible for:
  - a. opening vocal folds (as in breathing, coughing)

b. closing vocal folds for vocal fold vibration during voice use

c. closing vocal folds during swallowing

(For more information, see *Anatomy & Physiology of Voice Production*.)

## Basis of Name

The recurrent laryngeal nerve or RLN is called such because its path "recurs," i.e., goes into the chest cavity and curves back into the neck until it reaches the larynx.

## Long Course = Increased Risk for Injury

Because the RLN is relatively long and takes a "detour" to the voice box, the RLN has greater risk of injury from quite different causes – such as infections and tumors of the brain, neck, chest, or voice box; as well as complications during surgical procedures in the head, neck, or chest regions – that directly injure, stretch, or compress the nerve.

(For more information, see *Anatomy & Physiology of Voice Production*.)

## Increased Risk for Injury = Majority of Cases

Consistent with its longer course and corresponding higher risk for injury, the recurrent laryngeal nerve is involved in majority of cases of vocal fold paresis or paralysis.

## What are the causes of vocal paralysis/paresis?

| Cause                                     | Effects on Laryngeal Nerves<br>RLN: Recurrent Laryngeal Nerve<br>SLN: Superior Laryngeal Nerve   |
|---|--|
| Inadvertent injury during surgery         | Because of the length of the RLN, surgery in the neck (e.g., surgery of thyroid gland, carotid artery) or surgery in the chest (e.g., surgery of the lung, esophagus, heart, or large blood vessels) may inadvertently result in RLN paresis or paralysis. The SLN may also be injured during head and neck surgery.   |
| Complication from endotracheal intubation | Very rarely, injury to the RLN may occur when breathing tubes are used for general anesthesia and/or assisted breathing (artificial ventilation). However, this type of injury is rare, given the large number of operations done under general anesthesia.  |
| Blunt neck or chest trauma                | Any type of penetrating, hard impact on the neck or chest region may injure the RLN; impact to the neck may injure the SLN.  |
| Tumors of the skull base, neck, and chest | Tumors (both cancerous and non-cancerous) can grow around nerves and squeeze them (compression), resulting in varying degrees of paresis or paralysis.   |
| Viral infections                          | Inflammation from viral infections may directly involve and injure the vagus nerve or its nerve branches to the voice box (RLN and SLN).   |
| Other causes                              | Systemic illnesses affecting nerves in the body may also affect the nerves to the voice box  |
| Unknown cause or idiopathic               | Despite advances in diagnostic technology, physicians are unable to detect the cause in about half of all vocal fold paralyses. These cases are referred to as idiopathic (due to unknown origins). In idiopathic cases, paralysis or paresis might be due to a viral infection affecting the voice box nerves (RLN or SLN) or the vagus nerve, but this cannot be proven in most cases. |

### Key Information

- Knowing the cause of vocal fold paralysis or paresis can provide clues as to whether the disorder will resolve over time

or whether it is most likely permanent.

- When a reversible cause is present, surgical treatment will most likely not be recommended given the likelihood of spontaneous resolution of the paresis or paralysis.

## **Who does vocal fold paresis/paralysis affect?**

### **Anyone – No Particular Age or Gender Susceptibility**

Vocal fold paresis/paralysis can happen at any age – from newborns to the very old, males and females alike, from a variety of causes.

### **Impact Varies According to Person's Voice Demands**

The effect on patients may vary greatly depending on the voice demands of the patient. For example, mild vocal fold paresis can be "devastating" to a singer's career, but have only a minimal effect on a computer programmer's career.

### **Case-to-Case Differences**

Even if the cause is the same, every case of vocal paresis/paralysis is always slightly unique because:

- Degrees of weakness of the voice box muscles vary
- Adaptation of other laryngeal muscles adapt varies
- Patient needs vary and are affected by gender, age, as well as overall health.

# Symptoms of Vocal Fold Paresis/Paralysis

## What do patients experience when they have vocal fold paresis or paralysis?

In general, vocal fold **paresis** and **paralysis** share many of the same symptoms – but differ in terms of severity. Symptoms associated with paresis tend to be less severe due to the fact that the vocal folds maintain some degree of mobility.

Both paresis and paralysis of voice box muscles result in voice changes and may also result in airway problems and swallowing difficulties.

### Common Patient Complaints (**Symptoms**)

|                   |  |
|-------------------|--|
| <b>Voice</b>      | <ul style="list-style-type: none"><li>• Hoarseness – croaky or rough voice</li><li>• Breathy voice – a lot of air with the voice, voice sounds like whispering</li><li>• Effortful phonation – extra effort on speaking</li><li>• Air wasting – needs lots of air pressure to produce usual conversational voice, such that patient runs out of air when speaking notes</li><li>• Double voice (<b>diplophonia</b>) – voice sounds like a "gargle"</li></ul> |
| <b>Airway</b>     | <ul style="list-style-type: none"><li>• Shortness of breath with exertion</li><li>• Noisy breathing (<b>stridor</b>)</li><li>• Ineffective or poor cough</li></ul>   |
| <b>Swallowing</b> | <ul style="list-style-type: none"><li>• Choking or coughing when swallowing food, drink or even saliva (<b>aspiration</b>)</li><li>• Food sticking in throat</li></ul>   |

### Key Information

#### Note on Patient Complaints

- Patients may complain of any one or more of the above.
- Patient complaints (symptoms) vary. There are many factors that affect what happens to the voice when vocal fold paresis or paralysis is present, such as:

Vocal fold position within the voice box

Which nerves and the number of nerves affected

Remaining (residual) strength or tone of the affected vocal fold(s)

### Red Flag

Breathing difficulties and/or swallowing difficulties should be attended to immediately.

## How do vocal fold paralysis and paresis affect voice and breathing?

### Vocal Fold Paralysis

Vocal fold **paralysis** results in incomplete opening and closing of the opening to the airway (**glottis**) due to the inability of the vocal folds to move.

- **Importance of Vocal Fold Opening:** Inability of the paralyzed vocal fold to open results in poor glottal opening which leads to breathing problems (**airway symptoms**) that can be life threatening.
- **Importance of Vocal Fold Closing:**

For normal speaking and singing, both vocal folds need to be aligned in the midline, "closed." In this position, the air pressure from the lungs passes through the vocal folds making them vibrate. Vocal fold vibration allows periodic puffs of air to pass through – producing a voiced sound frequently described as "buzzy." This voiced sound is then modified by the throat, mouth, and nasal cavities (**vocal tract resonators**) and converted to words (**distinguishable sound**) by the tongue, lips, and palate (**vocal tract articulators**). *(For more information, see Anatomy & Physiology of Voice Production.)*

When vocal folds are not aligned in the midline, vocal vibration is hampered – hence the voice disorder.

For normal swallowing, vocal folds close to protect the windpipe below it. Failure to close causes swallowed food, drink, or saliva to enter the windpipe causing choking (aspiration).

## Vocal Fold Paresis

- **Weak and Low Tone, But Moving:** **Vocal fold paresis** results in a vocal fold that can still move – albeit weakly and with less tone than normal.
- **Subtle Complaints:** Typically, patient complaints are more subtle in vocal fold paresis than paralysis – primarily because the vocal folds still retain some ability to open and close normally. Rather than hoarseness, patients with paresis may just complain of:
  - voice tiring with moderate or heavy use (vocal fatigue)
  - voice cracking (voice instability or voice break)
  - normal speaking voice sometimes, depending on muscles involved, but inability to sing high notes (loss of pitch range)
- Breathing and swallowing problems are much less common.

## Does it matter whether one or both vocal folds is affected?

- Vocal fold paresis and paralysis can affect either one or both of the vocal folds.
- Whether one or both vocal folds are afflicted with paresis/paralysis determines patient complaints as well as considerations for treatment plan.

| <b>One Side Affected</b><br><b>Unilateral Paresis/Paralysis</b>   | <b>Both Sides Affected</b><br><b>Bilateral Paresis/Paralysis</b>  |
|---|---|
| <p><b>What's Wrong – Pathology</b></p> <p>Depending on the muscle involved, paresis/paralysis of one vocal fold could result in one or more of the following:</p> <ul style="list-style-type: none"> <li>• Poor closing or failure to come to midline</li> <li>• Reduced or no vocal fold tension or tone</li> <li>• Poor opening</li> <li>• Vocal fold asymmetry</li> <li>• Loss of or decreased muscle mass (vocal fold atrophy)</li> </ul> | <p><b>What's Wrong – Pathology</b></p> <p>Depending on the muscles involved, paresis/paralysis of both vocal folds would result in:</p> <ul style="list-style-type: none"> <li>• Vocal fold immobility               <ul style="list-style-type: none"> <li>Poor opening or failure to open</li> <li>Poor closing or failure coming to midline</li> </ul> </li> <li>• Loss of tone</li> <li>• Vocal fold atrophy</li> <li>• Vocal fold asymmetry</li> </ul> |
| <p><b>Effect on Voice – Common Complaints</b></p> <p>Inability or difficulty of one vocal fold to come to midline, poor or no vocal fold tone, poor tone control, vocal fold asymmetry,</p>   | <p><b>Effect on Voice – Common Complaints</b></p> <ul style="list-style-type: none"> <li>• If paralyzed vocal folds are in "close approximation"</li> </ul>   |

decrease vocal fold mass, result in one or more of the following—in any combination and in a wide range of varying degrees:

- Abnormal vocal fold vibration – hoarseness, harsh voice, abnormal voice quality (**timbre**), strained voice, weak voice, difficulty projecting voice, "double" voice (**diplophonia**)
- Air leakage during voice production – breathy voice, air wasting
- Abnormal vocal fold vibration and air leakage result in compensatory effort – effortful phonation and vocal fatigue
- Loss of pitch slide and control – loss of glissando
- Loss of vocal range especially high notes – loss of pitch

with breathing (see below)

- If paralyzed vocal folds are in "open position" – same effects as in unilateral paresis/paralysis, BUT worse \*\*\*

### Effect on Breathing

- Mild, if any, breathing difficulty

### Effect on Breathing

- Significant airway problems result from poor opening of the vocal folds – requires immediate management.  
Noisy breathing on inspiration – inspiratory stridor  
Difficulty breathing

### Effect on Swallowing

- Choking on swallowing (aspiration)
- Aspiration leads to risk of lung infection

### Effect on Swallowing

- If paralyzed vocal folds rest in "open position," same effects as in unilateral paresis/paralysis, but worse

## Key Information

### Swallowing Difficulties

A person's ability to feel in the voice box and throat may also be abnormal in cases of vocal fold paresis/paralysis. Loss of ability to feel can make aspiration worse.

### Breathing Difficulties

Any breathing difficulty requires immediate medical attention.

# Diagnosis of Vocal Fold Paresis/Paralysis

## Identification of Vocal Fold Paresis/Paralysis

It is important to identify vocal fold paresis/paralysis and identify its cause(s).

### Multiple Step-Wise Process

A complete evaluation of a voice disorder caused by vocal fold paresis or paralysis needs to address the questions below.

1. Is vocal fold paralysis/paresis present?
2. Is the vocal fold paralysis/paresis one-sided (unilateral) or two-sided (bilateral) – i.e., are one or both vocal folds affected?
3. Which voice box muscle(s)/nerve(s) are affected?
4. What is the cause(s) of your vocal fold paralysis/paresis?
5. What is the likely outcome (prognosis) of the vocal fold paralysis/paresis – spontaneous recovery? permanent loss of motion? worsening?

## Is vocal fold paresis/paralysis present?

### Clues on Examination – Physical Signs

The examination of the voice box (**laryngeal examination**) by the laryngologist can provide important clues in determining whether vocal fold paresis or paralysis is present. During the examination, multiple aspects can be assessed such as vocal fold motion, strength, position, tension, mass, and overall voice function. *(For more information, see Overview of Diagnosis, Treatment & Prevention.)*

### Common Findings in Vocal Fold Paresis/Paralysis [One or More in Any Combination and Varying Degrees; Usually Worse With Paralysis]

|                                 |  |
|---------------------------------|--|
| <b>Altered Motion</b>           | <ol style="list-style-type: none"><li>1. Sluggish movement or hypomobility</li><li>2. Non-movement or immobility</li><li>3. Incomplete closure or bowing</li><li>4. Asymmetric movement</li><li>5. Decreased range of motion</li><li>6. Incomplete opening</li></ol> |
| <b>Altered Strength</b>         | <ol style="list-style-type: none"><li>1. Sluggish movement</li><li>2. Voice cracks or breaks on high notes normally reached by patient</li><li>3. Voice cracks or breaks on increasing loudness</li></ol>  |
| <b>Altered Position</b>         | <ol style="list-style-type: none"><li>1. Asymmetric position</li><li>2. <b>Axial rotation</b> or tilt in high-pitch phonation</li><li>3. Differences in vertical level of the two sides</li></ol>  |
| <b>Altered Tension and Mass</b> | <ol style="list-style-type: none"><li>1. Bowing</li><li>2. Floppy vocal fold or vocal fold flaccidity</li></ol>  |

|                               |   |
|-------------------------------|---|
|                               | <p>3. Loss of muscle mass or vocal fold atrophy</p> <p>Sometimes, a vocal fold with paresis moves normally but is reduced in size due to muscle atrophy (decrease in muscle mass from denervation).</p>   |
| <b>Altered Vocal Function</b> | <ol style="list-style-type: none"> <li>1. Voice that is rough, breathy, "double" or "gargly" voice (diplophonia)</li> <li>2. Decreased vocal range and/or pitch glide or glissando</li> <li>3. High pressure needed for speaking or singing</li> <li>4. Air leakage during speaking or singing</li> </ol> |

### **i** Key Information

#### **Immobility as Hallmark of Paralysis**

Immobile vocal fold is the hallmark of **vocal fold paralysis**; reduced speed of motion and/or reduced range of motion are often found in vocal fold paresis. Vocal motion is usually evaluated while the patient is breathing, sniffing, and making sound (voice production).

#### **Vocal Fold Immobility Not Equal to Vocal Fold Paralysis**

- These terms are not identical because a number of non-nerve related conditions (such as **joint arthritis**, **subglottic stenosis**, or **vocal fold trauma**) can also cause vocal fold immobility.
- These other causes need to be considered in the workup of the voice disorder.

#### **Paralysis Purely a Nerve-Related Problem**

The term "vocal fold paralysis" should only be used when a nerve-related problem causes the loss of normal vocal fold motion.

#### **Consideration of Systematic Illnesses**

Occasionally, degenerative or acute neurologic disorders such as **Parkinson's disease**, **multiple sclerosis**, and **brain stem strokes** can result in a voice disorder alone or before affecting the rest of the body. In these conditions, the paresis/paralysis is present but is part of a larger neurological disorder. A joint evaluation with a **neurolaryngologist** and a neurologist may be necessary to evaluate the myriad causes in this category.

## **Is vocal fold paresis/paralysis one-sided or two-sided?**

The examination of the voice box provides sufficient information to assess whether one or both vocal folds is/are abnormal. Determining whether one or both vocal folds are affected is important in the treatment plan.

## **Which muscles/which nerves are affected?**

Voice box muscles are named according to the cartilages to which they are attached.

### **Voice Box Nerves and the Muscles They Work On**

| <b>Recurrent Laryngeal Nerve (RLN)</b>   | <b>Superior Laryngeal Nerve (SLN)</b>   |
|--|---|
| <p>Muscles That Open and Close Vocal Folds</p> <ul style="list-style-type: none"> <li>• Thyroarytenoid muscle</li> <li>• Lateral cricoarythenoid muscle</li> </ul> | <p>Muscle That Adjusts Tension of Vocal Folds</p> <ul style="list-style-type: none"> <li>• Cricothyroid muscle</li> </ul> |

- Posterior cricoarythenoid muscle
- Inter-arytenoid muscle

The RLN brings nerve inputs to most muscles of the voice box.

*(For more information, see Anatomy & Physiology of Voice Production.)*

## Confirmatory Test

**Identification and assessment of outcome:** Depending on the suspected cause, a variety of tests may be ordered. One of the more important tests is laryngeal electromyography (LEMG). *(For more information, see LEMG.)*

### In Brief

LEMG measures electrical currents in the voice box muscles that are the result of nerve inputs. Measuring and looking at the pattern of the electric currents provides key clues about:

- Whether the voice box muscle is paralyzed or paretic
- Whether there is some hint of recovery or repair of nerve inputs (re-innervation)
- The degree of the nerve input problem.

### How is the test done?

LEMG involves the insertion of small needles that can measure electrical currents in the vocal fold muscles. During LEMG patients perform a number of tasks that would normally elicit characteristic actions in the tested muscles.

### "Signatures" of Nerve Input

Paralysis and paresis have their typical "signatures" of electric current pattern. Certain electrical signatures from muscle are quite characteristic of nerve injury and repair. These electrical patterns give the clinician insight as to the timing, duration, and severity of the nerve injury.

**Note:** In some cases of arthritis or laryngeal joint problems, the nerve activity is normal. This will point the diagnosis away from that of paresis and paralysis.

### LEMG Provides Clues to Outcome

In many cases, LEMG is a useful indicator in determining outcome (prognosis) of a patient's condition.

#### Key Information

##### Subtle Clues

Vocal fold paresis results in a decrease of vocal fold movement, as well as voice weakness and low tone. These findings and the patient complaints associated with them are milder and more subtle in vocal fold paresis than in paralysis.

##### LEMG Role in Identification

Vocal fold paresis is not easily recognized because vocal fold motion is still present. Identification of vocal fold paresis may require LEMG studies which can detect abnormalities in electrical signals of muscles (**electromyographic abnormalities**) in the presence of seemingly normal vocal fold motion.

## What's the cause?

### Clues From Voice Box Exam

Determining whether vocal fold paresis/paralysis is one-sided or two-sided directs where to look for the probable cause. Likewise,

knowing which muscles are affected also provides clues as to which nerve, whether RLN or SLN or both, is affected. Knowing which nerve is affected also directs where to look for the probable cause.

## Clues From General Exam

The presence of a systemic illness provides clues as to possible causes as well as guidelines for treatment plans.

## Further Testing to Determine Cause

Because there is a wide list of diseases that may cause a nerve to be injured, further testing is usually necessary (blood tests, x-rays, CT scans, MRI, etc.) to identify the cause(s) of vocal fold paresis/paralysis.

For example, a neurological consultation may be requested to see if there are nerves other than those to the voice box (RLN and/or SLN) affected. According to current best practices, a CT scan of the skull base to the chest may be ordered to check for masses that may be pushing on the nerve as it travels to the larynx from the base of the brain. Laboratory tests such as screening for diabetes, thyroid disease, and infectious and immune disorders may be ordered to make sure the laryngeal paralysis is not part of a more systemic disorder. *(For more information, see How Breakdowns Result in Voice Disorders and Voice Dysfunction in Neurological Disorders.)*

### Red Flag

#### Need to Pursue Diagnosis

Persistent hoarseness or voice symptoms should not be left without diagnosis.

#### Voice Center Consultation

When the cause of persistent hoarseness remains a problem, referral to a voice center where more extensive testing can be done is the best course of action. These cases are often diagnosed as vocal fold paresis by Voice Centers. In some cases of vocal fold paresis, the differences in vocal fold motion impairment may be quite subtle and must be brought out by repetitive testing.

#### Masking of Vocal Fold Paresis

A more prominent diagnosis can mask the diagnosis of vocal fold paresis. Vocal fold paresis, when present with functional muscle tension dysphonia, is usually overlooked.

## Why is determining the cause of vocal fold paresis/paralysis important?

Even if the physician has determined that the vocal fold immobility is due to nerve paralysis, determining the underlying cause of vocal fold paralysis is important.

For example, vocal fold paralysis may be due to cancer compressing or involving the nerve. The paralysis could be the first symptomatic manifestation of the tumor. Thus it is crucial for the physician to carefully look along the paths of the vagus and recurrent laryngeal nerve for a cancer that could be invading the nerve and causing the vocal fold paralysis. Cancers that commonly cause a vocal fold paralysis are cancers of the lung, esophagus, and thyroid gland. Thoracic malignancies (cancerous tumors growing in the chest) that grow on top of nerves in the chest are also one of the more common causes of paralysis. Clearly, early diagnosis of cancer would impact the overall treatment course.

## A Note on Cancer as Cause

Most vocal fold paralysees are not caused by cancer. However, the importance of making a diagnosis of cancer promptly, if cancer is the cause of vocal fold paralysis, is so important that current best practices suggest that every patient who develops vocal fold paralysis should be evaluated for possible nerve compression by tumor.

### Red Flag

#### Identification of Vocal Fold Paresis Is Frequently Missed

Since its patient complaints with paresis can be mild and hardly noticeable, as well as so similar to those of other voice

disorders, the disorder can be easily misdiagnosed.

### **Hard-to-Find Clues**

Often, the only physical sign of paresis present is a slight asymmetry in the opening and closing motions of the vocal folds, or a slight variation in the tension of the two folds. These findings can be subtle and can be easily missed on examination of the voice box.

### **Importance of Careful Voice Box Examination**

The importance of a careful and detailed throat and voice box examination cannot be overestimated.

### **Role of LEMG**

Testing by LEMG plays a major role in definite identification of vocal fold paresis.

### **Red Flag**

Any and all airway problems require immediate attention.

# Treatment of Vocal Fold Paresis/Paralysis

## What are the treatment approaches to vocal fold paresis and paralysis?

Currently, there are two main intervention approaches to vocal fold paresis/paralysis which improve vocal function:

1. **Voice therapy:** The equivalent of physical therapy for large muscle paresis/paralysis
2. **Phonosurgery:** Operation that repositions and/or reshapes the vocal fold(s) to improve voice function

After voice therapy, the decision to have some type of surgery is complex. Among the important factors in decision making are the severity of the symptoms, vocal needs of the patient, position of paralyzed vocal folds, prognosis for recovery, and cause of paresis/paralysis if known. There is no "one size fits all" in this area.

### Key Information

#### A Third Approach – "Sit and Wait"

LEMG results may suggest that the hope for natural recovery is good. This justifies waiting from 4 to 12 months to see if vocal fold paresis/paralysis resolves and voice improves.

## Voice Therapy

### In Brief

Patients are taught through several (2-12) one-on-one sessions to maximize the voice intensity and quality using a variety of breathing and muscle exercises.

### Role in Vocal Fold Paresis

Voice therapy for vocal fold paresis is often successful in improving voice function and may be the only intervention required.

### Role in Vocal Fold Paralysis

Generally, voice therapy will improve voice function of patients with vocal fold paralysis by about 5 to 15 percent. Although this may not seem to be a dramatic improvement, for patients whose voice use is limited, or for those who do not wish to undergo surgery, it may represent a sufficient gain.

### Factors Determining Voice Therapy Outcome

Success of voice therapy for vocal fold paralysis depends on a variety of factors: the nature and position of the paralyzed vocal fold and the patient's voice demands. (*For more information, see Voice Therapy.*)

## Surgical Intervention

There are two main surgical options for surgically treating paresis/paralysis.

1. [Laryngeal injection augmentation](#)
2. [Laryngeal framework surgery](#)

Both attempt to improve vocal fold closure in order to improve vocal fold vibration.

| Method                     | Description   |
|----------------------------|---|
| <b>Laryngeal Injection</b> | <b>In Brief:</b> Injection of a variety of synthetic or natural materials into the vocal fold |

|  |  |
|--|--|
| <b>Augmentation</b><br>(also called vocal fold injection, vocal fold augmentation) | <b>Goal:</b> To optimize vocal fold closure in order to enhance vocal fold vibration, thus improving voice   |
| <b>Laryngeal Framework Surgery (LFS)</b>   | <b>In Brief:</b> Implantation of a small device into the vocal fold to optimize its position for better closure during speaking or singing (medialization technique)<br><br><b>Goal:</b> To optimize vocal fold closure in order to enhance vocal fold vibration, thus improving voice |

### Key Information

#### **Voice Adjustments Under Local Anesthesia**

Because laryngeal framework surgery is done under local anesthesia with the patient awake, the surgeon is able to monitor the voice during the surgery and the implant can be adjusted to optimize voice improvements. In this way, voice adjustments can be done during the procedure.

#### **Role for Both Procedures**

Decision as to the optimal type of surgical intervention depends on the patient's individual case. Sometimes, one approach may make more treatment sense. In some cases, both surgical approaches may be necessary.

#### **Similar Goals**

Both laryngeal injection augmentation and laryngeal framework surgery have the same goal – better vibration of the vocal folds during the speaking and singing.

#### **A Current Prospective**

The actual technique used is likely to depend on the specific aspects of a patient's particular case, as well as physician's training and preferences.

## **Special Considerations**

- **Professional voice users:** Professional voice users usually need special considerations in selecting treatment pathways. Consultation with a voice center's Voice Care Team provides a best care practice.
- **Swallowing or breathing problems:** If swallowing and/or breathing problems accompany vocal fold paresis/paralysis, surgery would be required earlier.

## **Role of LEMG in Decisions**

Treatment decisions and prognosis for recovery may be guided by LEMG results.

## **What are the possible complications of treating vocal fold paralysis/paresis?**

Readers are advised to discuss possible side effects and complications with their physicians.

As with all surgery, complications may occur.

## **Complications Observed in Laryngeal Injection Augmentation**

1. Underinjection (of substance), which results in persistent breathiness or vocal fatigue
2. Overinjection (of substance), which results in strained voice and/or breathing difficulties
3. Reaction to injection substance

4. Injection substance does not last to provide benefit

### **Complications Observed in Laryngeal Framework Surgery**

1. Airway obstruction and/or swelling which may result in breathing difficulties
2. Undercorrection which may result in persistent breathiness and/or vocal fatigue
3. Overcorrection which may result in strained voice and/or breathing difficulties
4. **Graft migration** – the implant does not stay in the place where the surgeon put it
5. **Implant extrusion** – implant is "rejected" and pushed outwards

# Vocal Fold Paresis/Paralysis: Frontiers

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## What new treatments are being investigated?

### New Implant Materials

New implants and injections for surgical intervention are developed quite frequently and some are providing more consistent results.


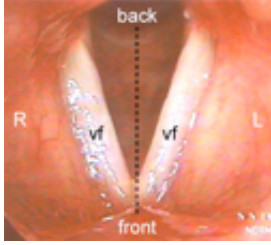
### Re-Innervation Approaches

Re-establishing nerve inputs to the voice box muscles, **laryngeal re-innervation**, is not yet a viable treatment option, but significant advances and research are under way. Laryngeal re-innervation would be optimal because it would, in theory, allow the paralyzed vocal fold to be able to move or become dynamic again. This would be a significant improvement from the present adynamic, "re-positioning" approach available today.

Transferring of nerves (**nerve transposition**): involves taking nerve and muscle from another part of the body and grafting the new nerve into the paralyzed vocal fold. The hope is that this healthy nerve would grow to the point where it could deliver signals and messages from the brain on a consistent basis – and thus improve voice.

# Images of Vocal Fold Paresis/Paralysis

## A Representative Image of a Paralyzed Vocal Fold

| One-Sided Vocal Fold Paralysis  | Normal Vocal Folds   |
|---|--|
|  <p data-bbox="90 583 800 720">Paralyzed left vocal fold (*vf) is foreshortened and appears "fatter" due to loss of muscle tone; the surrounding areas (indicated by yellow arrows) are also affected and seem to "collapse" onto the vocal folds in contrast to normal vocal folds.</p> |  <p data-bbox="841 625 1511 695">Normal vocal folds on inspiration (open); note right and left vocal folds open equally from the imaginary midline [-----].</p> |

This diagram can be found in Vocal Fold Paresis/Paralysis: Understanding the Disorder.

# Vocal Fold Paresis/Paralysis: Vocabulary

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## **Paresis**

Partial paralysis; partial loss of nerve input to a muscle, resulting in muscle weakness

## **Paralysis**

Complete loss of nerve input to a muscle resulting in complete loss of muscle function

## **Laryngeal Electromyography (LEMG)**

Test that measures electrical signals of nerve inputs to muscles

## **Recurrent Laryngeal Nerve (RLN)**

Branch of vagus nerve to voice box muscles that open and close vocal folds

## **Superior Laryngeal Nerve (SLN)**

Branch of vagus nerve to cricothyroid muscle involved in control of pitch

 **Advisory Note**

Patient education material presented here does not substitute for medical consultation or examination, nor is this material intended to provide advice on the medical treatment appropriate to any specific circumstances.

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