Fundamentals of Vocal Fold Anatomy and Physiology

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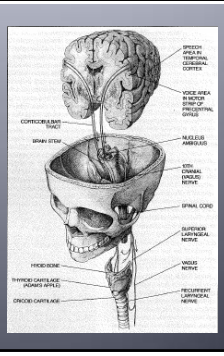
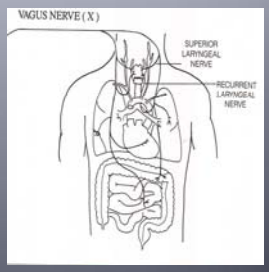
Neuroanatomy of the Larynx: Central Nervous System

- Cerebral cortex → precentral gyrus in the motor cortex → motor nuclei in the brainstem and spinal cord
- Additional refinement in cerebellum and basal ganglion
- Auditory feedback facilitates fine-tuning



Neuroanatomy of the Larynx: Peripheral Nervous System

- Cranial Nerve X: The Vagus Nerve
- Innervates the larynx via the superior and recurrent laryngeal nerve
- Contain all sensory and motor fibers that supply the larynx



Neuroanatomy of the Larynx: Peripheral Nervous System cont'd

- Superior Laryngeal Nerve
  - Internal Branch: Provides all sensory input to larynx
  - External Branch: Motor input to the CT only
- Recurrent Laryngeal Nerve
  - Sensory input to below the cords
  - Motor input to the PCA, TA, LCA, and IA muscles

Laryngeal Framework

- Hyoid bone
- Three unpaired cartilages
  - Epiglottis
  - Thyroid
  - Cricoid
- Three paired cartilages
  - Arytenoid
  - Corniculate
  - Cuneiform cartilages

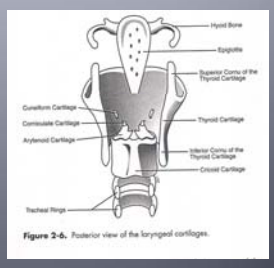


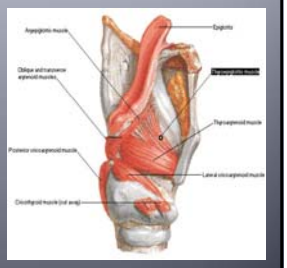
Figure 2-6. Posterior view of the laryngeal cartilages.

Extrinsic Laryngeal Muscles: Suprahyoid and Infrahyoid

Suprahyoid		Infrahyoid	
Stylohyoid	Raises hyoid posteriorly	Thyrohyoid	Decreases distance between hyoid and thyroid
Mylohyoid	Raises hyoid anteriorly	Sternothyroid	Lowers thyroid
Digastric (Anterior/ Posterior)	Raises hyoid anterior/ posteriorly	Sternohyoid	Lowers hyoid
Geniohyoid	Raises hyoid anteriorly	Omohyoid	Lowers hyoid

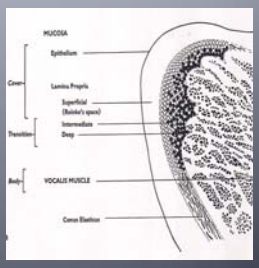
Intrinsic Laryngeal Muscles

- Interarytenoid
  - Adducts arytenoids
- Lateral Cricoarytenoid
  - Adducts vocal processes of the arytenoids
- Posterior Cricoarytenoid
  - Abducts arytenoids
- Cricothyroid
  - Lengthens and tenses the membranous folds, increasing pitch
- Thyroarytenoid
  - Shortens the folds and decreases tension, decreasing pitch



Vocal Cord Histology

- A "multilayered" vibrator.
- Each level contributes a graduated change in mass and compliance for vibration
- The area at and around the vocal fold edge moves most markedly during phonation.



Vocal Cord Histology: Five Histologic Layers

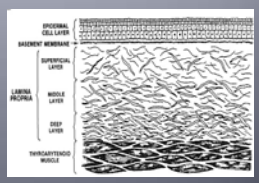
- Epithelium
  - Thinnest, consisting of only 6 – 8 cell layers
  - Totally compliant, but requires lubrication
- Lamina Propria
  - Superficial
    - "Reinke's space"
    - Invasion of lesion or violation of pliability in any way will significantly impair vibratory waveform
  - Intermediate: Made up of elastic fibers
  - Deep: Made up of collagen fibers
  - (Intermediate and Deep Layers = Vocal Ligament)

Lamina Propria: Extracellular Matrix

- Fibrous Proteins
  - Elastin: Large dynamic range, allowing tissue deformation and recoil
  - Collagen: Does not stretch easily but can tolerate a great deal of stress
- Interstitial Proteins
  - Hyaluronic acid: Attracts water to form large, space-filling molecules
  - Seems to act as a cushion, resisting compression and shearing effects
  - Concentration is 3:1 male to female vocal cords, may explain difference in injury types and prevalence

Basement Membrane Zone

- Transition between epithelium and superficial lamina propria
- Displays evidence of mechanical trauma and shearing injury in injured vocal folds



Vocal Cord Histology: Vocalis Muscle

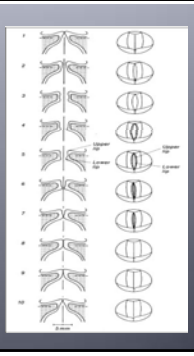
- Vocalis Muscle (Thyroarytenoid)
  - The terms "vocalis" and "thyroarytenoid" often used interchangebly
  - Two components:
    - Thyromuscularis: Lateral component
    - Thyrovocalis (aka Vocalis): Medial component
  - The "body" of the vocal cord, provides mass and tonicity
  - Because of innervation, the only true "active" vocal cord tissue

Tissue Variations/ Connective Tissue

- Anterior commissure tendon (Broyles tendon)
- Anterior and posterior macula flava
  - Support vocal cords at points of greatest mechanical stress
- Conus elasticus: Supports inferior border of the folds

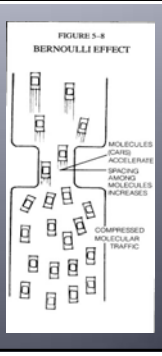
Aerodynamic-Myoelastic Theory

- Accounts for both aerodynamic and muscular forces
- Describes the reciprocal role of airflow, subglottal pressure, and transglottal flow as they interact with vocal cord resistance and elasticity



Bernoulli Principle

- "The sum of the static and kinetic pressures in a gas is always equal to a constant."
- An area of negative pressure in the glottis causes the cords to be "sucked" back together



Body-Cover Theory

- The five layers can be re-classified in a mechanical sense into the…
  - Cover: Epithelium and superficial layer of the lamina propria
  - Transition: Vocal ligament
  - Body: Vocalis muscle
- Cover and transition vibrate passively… vocalis muscle vibrates both actively and passively

Body-Cover Theory, continued

- Accounts for the mass/ stability provided by the vocalis over which the flexible superficial layers oscillate, while the transition serves as the coupling between mucosa and deep muscle
- This oscillation – a visible ripple of tissue deformation and recoil, offers enhanced diagnostic information via videostroboscopy

Clinical Assessment of Vocal Cord Vibration

- Clinically, vibration should be described in at least three vibratory phases of wave motion.
  - Horizontal (medial to lateral)
  - Longitudinal (anterior to posterior)
  - Vertical (inferior to superior opening and closing)
- Accurate interpretation provides vital diagnostic interpretation!

Parameters to Describe Vibratory Patterns

- Amplitude
  - Medio-lateral displacement
- Phase closure
  - Open/ closed
- Mucosal wave
  - Longitudinal flexibility
- Symmetry
- Periodicity
- Vibrating portion

Laryngeal Imaging

The Fundamentals Rigid and Flexible Endoscopy

Barbara P. Messing, M.A., CCC-SLP, BRS-S
April 8, 2011
The Milton J. Dance, Jr. Head & Neck Center
The Johns Hopkins Voice Center at GBMC

The Value of Laryngeal Stroboscopy

Provides information regarding

- Ability of system to achieve an efficient prephonatory/nearly closed configuration
- Pliability of the cover
- Stroboscopy refers to the observation of vocal fold vibratory characteristics and **not** the observation of vocal fold abduction and adduction

Courey, 2006

Laryngeal Stroboscopy: Training for Professionals

- "Although specific experiences may differ among professionals, the interpretation and clinical use of laryngeal stroboscopy information in the assessment and treatment of phonatory function disorders is highly specialized and requires substantial training and knowledge beyond that believed to be available in most graduate speech-language pathology or laryngology residency programs."
  - Leonard, R.J. (1992). Use of laryngeal imaging procedures. *Asha, 34*, 270.

Evaluation: Instrumental Assessment

- Ideally, both a rigid and flexible video stroboscopy should be performed
- Rigid endoscopy – looking for vocal fold edge/pliability/wave, glottic closure, open/close phase
- Flexible endoscopy --- looking for vocal fold parameters and supraglottic behavior during actual speaking and singing
- Sustained /i/ at **varied pitch and loudness** – essential to correct diagnosis

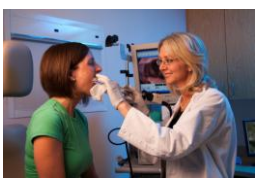
Rigid Endoscope

- Best image clarity
- 70 or 90 angle lens
- Hyperactive gag response may prevent use
- Often tension artifact
- Normal speech tasks not possible

Rigid Endoscopy

VIEW OF THE LARYNX USING RIGID ENDOSCOPY

SCOPING A PATIENT



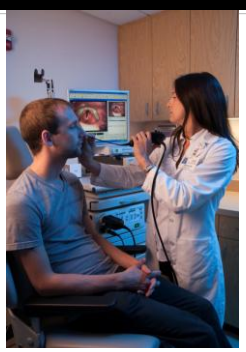
Performing Endoscopy

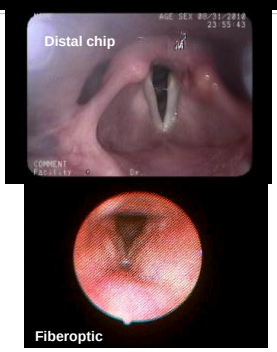
- Topical anesthetic and decongestant
- Either patient or examiner holds tongue w/ gauze
- Scope inserted to the base of tongue and angled downward
- Sustained /i/ at varied pitch and loudness

Flexible Endoscopy

- Fiberoptic vs. digital ("distal chip")
- Often better tolerated
- Allows exam during speech/ singing
- Visual biofeedback
- Preferred if motion impairment, SD, or MTD suspected

Flexible Endoscopy





Digital vs. Fiberoptic Flexible Nasoendoscopy

Performing Endoscopy

- Topical anesthetic and decongestant
- Either patient or examiner holds tongue w/ gauze
- Scope inserted to the base of tongue and angled downward
- "Thinker" pose
- Sustained /i/ at varied pitch and loudness

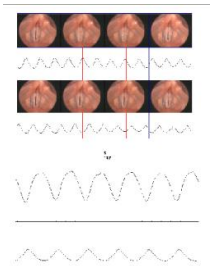
http://www.kayelemetrics.com/Product%20Info/Strobe%20Systems/9295.htm

Evaluation: Instrumental Assessment

- Ideally, both a rigid and flexible video stroboscopy should be performed
- Rigid endoscopy – looking for vocal fold edge/pliability/wave, glottic closure, open/close phase
- Flexible endoscopy --- looking for vocal fold parameters and supraglottic behavior during actual speaking and singing
- JHH Voice Center Protocol…

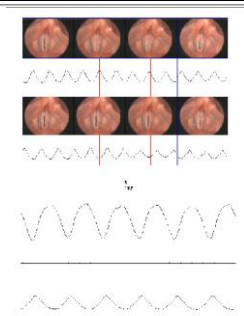
Stroboscopy

- In traveling mode, light flashes at different points in the vibratory cycle – slow motion effect
- In locked mode, light flashes at same point in each cycle – image appears still



Stroboscopy

- Founded on Talbot's Law
- A contact microphone reads fundamental frequency (pitch)
- Uses a flashing xenon light to sample many single points along multiple waveforms in accordance with pitch produced by patient
- Allows a locked or traveling image of the folds



Light Source - Halogen

- Halogen
  - Steady
  - Continuous light
  - Allows clear visualization of anatomical structures
- Limitations
  - Vibratory behavior of the vocal folds cannot be seen

Halogen vs. Xenon Light

Locked/Traveling Modes

Scope Selection

- Rigid Examination
  - Ideal if close view of pathology is needed
  - Excellent for evaluating vibratory patterns
  - May elicit abnormal muscular movement secondary to unnatural positioning
- Flexible Examination
  - Offers a more natural production
  - Allows observation of voice production during connected speech
  - Subject to intermittent changes in view as patient alters position of the velum, base of tongue, or swallows

Stroboscopy - Disadvantages

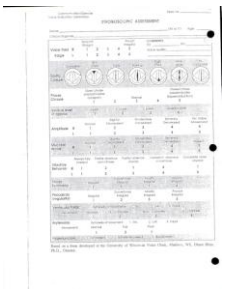
- Representation of vibration – not actual cycle
- Two-dimensional
  - Superior surface view - only
  - Unable to evaluate lower lip region when upper lip region is closing or closed
- If patient is too dysphonic, pitch recording, and therefore strobe, not possible

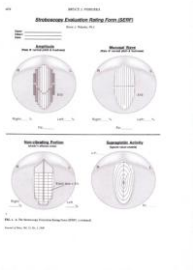
Normal Vibratory Characteristics

- A universal rating system and/ or scale does not exist
- Evaluation is subjective and dependent on the skill of the examiner
- Videostroboscopic Examination of the Larynx, M. Hirano and D. Bless, 1993, Singular Publishing

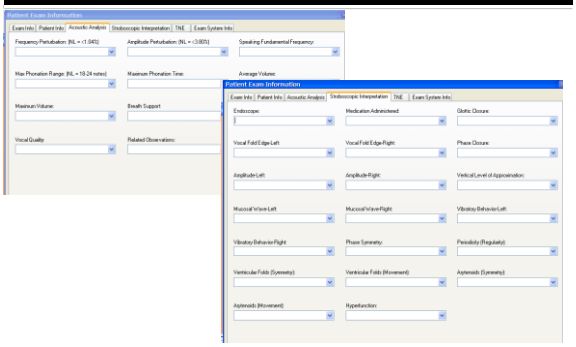
- Phase closure
- Amplitude
- Mucosal wave
- Symmetry
- Periodicity
- Vertical plane

SAV and SERF





KayPentax Report Module



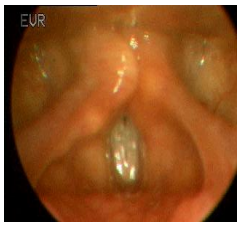
Visual Perceptual Judgements

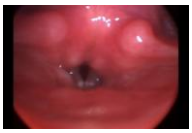
- Not vibratory characteristics, but simple observation of
  - Overall structural appearance of the larynx, including remarks on color, mucous
  - Symmetry and movement of arytenoids
  - Vocal fold edge (smooth, rough, edema, lesion, etc.)
  - Glottic closure pattern
  - Supraglottic hyperfunction

Glottic Closure Pattern

- Complete
- Incomplete
- Bowed
- Hourglass
- Anterior gap
- Posterior gap
- Spindle gap

Supraglottic Hyperfunction (Muscle Tension Dysphonia)





Amplitude

- The extent of vertical-lateral excursion, the extent of lateral displacement from midline
- R/L judged separately
- Normal, mild-mod-severely reduced, absent
- Presence of lesion, edema, stiffness, hyperfunction will affect amplitude
- The product of subglottic pressure

Amplitude

Mucosal Wave

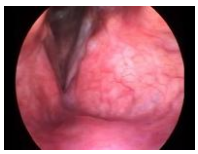
- The longitudinal flexibility of the fold, seen as a traveling wave on vibration
- Absence of mucosal wave described as a "non-vibrating portion" or "adynamic segment"
- May appear increased in cases of paresis/ paralysis secondary to flaccidity
- R/L judged separately
- Normal, mild-mod-severely reduced, absent

Mucosal Wave

Symmetry

- Based on the degree to which the two folds appear as mirror images of one another
- Consider timing of opening, closing, approach to midline, excursion, etc.
- Symmetrical, sometimes, mostly, always irregular

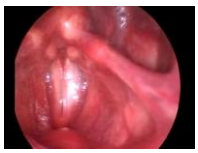
Symmetry

Periodicity

- The regularity of successive apparent cycles of vibration
- Periodic vibration is uniform in time and amplitude, aperiodic is not
- Periodicity reflected by a static image in the "locked" mode
- Some application in diagnosis of SD

Periodicity

Phase Closure

- Describes the ratio of open to closed phase
- Open phase may be increased in cases of presbylarynx, glottal lesion, paralysis
- Closed phase may be increased in cases of hyperfunction
- Open phase or closed phase predominates, mostly/ somewhat open or closed

Phase Closure


Vertical Plane/ Phase Difference

- Vocal folds should meet in the same horizontal plane
- A vertical discrepancy affects upper lip/ lower lip adduction, impacting other vibratory characteristics
- Vertical plane may be affected by paralysis, CA joint injury
- Equal, right/ left lower

Vertical Phase Difference

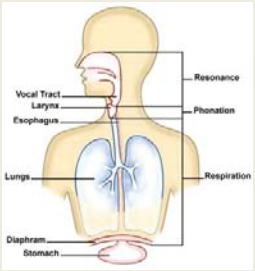
The Value and Implementation of Acoustic Measures

LISA VALASEK, M.S. CCC-SLP

A Show of Hands…

Objective Measurements: Purpose

- When used appropriately, instrumental measures provide critical information about the respiratory, laryngeal, and phonatory behaviors in voice production.



Objective Measures:

- The utility of any tool is only as appropriate as the user's knowledge
- Validity and reliability of your measures depends on your knowledge and accuracy of instrument calibration, use, analysis and interpretation

Objective measures:

- ***With these tools, can you***:
  - IDENTIFY THE EXISTENCE OF A VOICE DISORDER (DETECTION)?
  - ASSESS THE SEVERITY OR STAGE OF PROGRESSION OF THE VOICE PROBLEM (SEVERITY) ?
  - IDENTIFY THE DIFFERENTIAL SOURCE OF THE VOICE PROBLEM (DX)?
  - SERVE AS A PRIMARY TREATMENT TOOL FOR MODIFICATION, BIOFEEDBACK, OR PATIENT EDUCATION (TX)?

Cautions About Using Normative Data

- There is wide variation in "normal voice"
  - Hence large ranges standard deviations
- Normative data are constantly being gathered
- Norms vary due to the sophistication of the equipment used to gather norms
- Voice is dynamic; not constant

Acoustic Assessment: Why Add Objective Measures?

- To confirm and clarify your perceptions
- To quantify your subjectivity
- To validate your therapy
- Numbers translate to dollars
- They add to but do not replace a trained ear

Important Acoustic Measurements

- Speaking Fundamental Frequency and Average Volume
  (Cue: "Tell me your name and today's date at normal pitch and volume")
- Maximum Phonation Range (Pitch Range)
  (Cue: " Scale from your lowest pitch to your highest pitch")
- Maximum phonation time
  (Cue: " Take a deep breath and hold 'ah' for as long as you can")
- Frequency Perturbation (Jitter)
- Amplitude perturbation (Shimmer)
- Noise to Harmonics Ratio

Acoustic Assessment: What do you need?

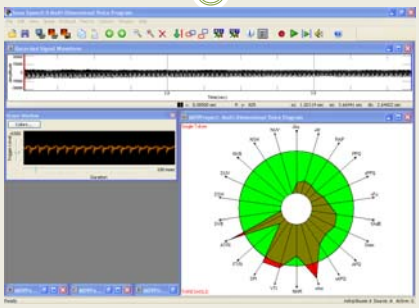
- Microphone and quiet recording environment
  - Placement of mic is key: constant mic-mouth distance
- Acoustic recording and analysis equipment (i.e. Kay Pentax Sona-speech or CSL)
- Sustained phonation and running speech tasks

Acoustic Measures of Quality

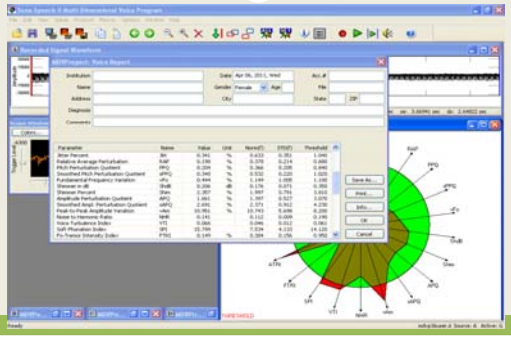
- **Signal/Harmonic: Noise Ratio** – comparing "good" voice (harmonics) to the "bad" voice (noise – i.e. roughness, breathiness)
  - "Normal" voices are mostly periodic and have high signal or harmonic energy
  - Dysphonic voices have large aperiodic components = lower harmonic energy
  - CAUTION: Variability in measurement (HNR vs. NHR)
- **Frequency perturbation "jitter"** – variations in frequency of successive vocal fold vibratory cycles
  - Jitter increases when pathologic lesion is present on the TVFs
- **Amplitude perturbation "shimmer"** – variations in amplitude of successive VF vibratory cycles
- MDVP

Kay Pentax Sona-Speech Menu

MDVP



MDVP Analysis



Fundamental Frequency (Fo):

- Rate of vibration of the vocal folds
- Expressed in Hertz (Hz)= cycles per second
- Audioperceptual correlate= pitch
- Fo range= highest to lowest pitch a patient can produce
- Mean Fo= Average (sustained phonation or average in connected speech)
- Good to measure throughout tx to compare pre- and post- tx measures

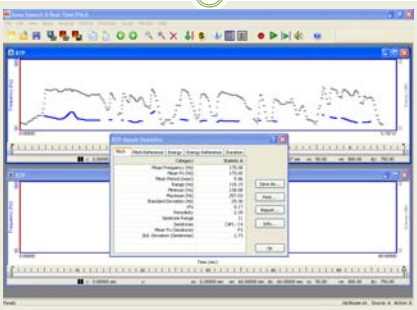
Pitch (Frequency)

- Determined by vocal fold mass, tension, and length as they relate to vibration
- Adult males: greater mass, longer VF, slower rate of vibration – lower voice
- Adult females: less mass, shorter VF, faster rate of vibration
- To achieve a higher pitch – VF lengthen, tension increases, mass/unit length decreases

Intensity = Amplitude = Loudness

- Amplitude= Acoustic correlate of loudness
- Measured in dB (decibels)
- Important to determine habitual loudness as well as max/min
- Created by increasing glottal resistance, causing build up of subglottal pressure so that when sound wave is released it has greater power (amplitude)

Real Time Pitch



Voice Types: Stemple's Classification

- **TYPE I**: Normal or mildly impaired voice
  - Acceptable for acoustic analysis
- **TYPE II**: Disordered voice (i.e. glottal fry, tremor, roughness)
  - Random, fluctuating periodicity makes acoustic analysis unreliable
- **TYPE III**: Severe dysphonia
  - Random, aperiodic signals with no identifiable Fo pattern thus unsuitable for acoustic analysis

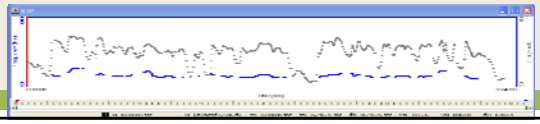
Are we all on the same page?

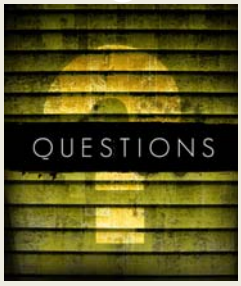
Can all voices be analyzed accurately with acoustic measures?

- How are mod-severely dysphonic voices assessed (Type II and III voices)?
  - Limitations of stroboscopy
  - Limitations of perturbation measures
  - Limitations of harmonic : noise ratio
- What's the answer?
  - Audio-Perceptual judgment; make recordings of pre-surgery or pre-tx voices

Applications in Dx and Tx

- Acoustic protocol with all voice evaluations
- Re-assessment at the beginning of each treatment session, monitor progress
- Waveform Editor: RECORD EVERYTHING
- LSVT
- Visual and Auditory Feedback (blue line)
- Helps with "buy-in"





JOHNS HOPKINS MEDICINE

Special considerations for diagnosis and treatment of neurogenic dysphonia

Heather Starmer, MA CCC-SLP
Assistant Professor
Department of Otolaryngology – Head and Neck Surgery
Johns Hopkins University

Vocal system

- Respiration (power)
- Phonation (sound)
- Amplification (resonance)
- Articulation (speech)

Neurogenic influence

- Initiation of motion
- Speed
- Range of motion
- Coordination
- Selective inhibition and disinhibition
- Muscular control-steadiness
- Muscle strength/tone

Common causes of neurogenic dysphonia

- Stroke
- Parkinsonism
- Myasthenia Gravis
- Multiple Sclerosis
- Spasmodic dysphonia
- Essential tremor

Methods of analysis

- Perceptual assessment
- Acoustic and aerodynamic analysis
- Physiologic evaluation (endoscopic/stroboscopic evaluation)
  - Sustained phonation
  - Repetitive, isolated muscle recruitment (sniffs for abduction, sniff followed by /i/ for adduction)
  - Pitch glides
  - Speech tasks

Other important considerations

- Course of symptoms
- Oral motor findings and motor speech
- Expressive and receptive language
- Eating and swallowing ability
- Gait, balance, posture and other neurological findings
- Respiratory difficulties

Pseudobulbar palsy

- Bilateral damage to corticobulbar tracts
  - Spasticity
  - Weakness
  - Reduced muscular range
  - Slowed movement
  - **Emotional lability**

Pseudobulbar palsy: Important background information

- Onset typically after acute neurological insult (CVA, TBI) but rarely associated with MS and CP
- cc: voice, speech, swallowing changes co-occurring with emotional lability

Pseudobulbar palsy Examination findings

- Subjective - Irregular prosody, articulatory imprecision, hypernasality, monotone, harsh/strained voice
- Endoscopic/stroboscopic – hyper adduction of TVF (closed phase predominates) and reduced amplitude
- Acoustic – reduced dynamic range
- Aerodynamic – Elevated subglottic pressure and decreased airflow

Pseudobulbar palsy Treatment options

- Voice therapy
  - Coordination of expiratory air and laryngeal muscular forces
  - Pacing strategies for prosodic difficulties
  - Task-specific strengthening exercises for weak laryngeal, articulatory, and velopharyngeal musculature
  - Pitch manipulation activities

Parkinsonism

- Progressive degeneration of basal ganglia
  - Rigidity
  - Slowed movement
  - Tremor
  - Reduced range of motion
  - **Reduced vocal loudness and pitch variability**

Parkinsonism Important background information

- Voice and swallowing complaints are often early symptoms -70-89% experience voice problems (Hartelius et al, 1994)
- Disease severity staged by Hoehn Yahr Scale

Stage	Description
I	Isolated unilateral involvement
II	Bilateral or midline involvement
III	Impaired righting reflexes(unsteadiness in turning or sudden change from a standing position)
IV	Severely disabling disease; patient can walk or stand but is otherwise incapacitated
V	Patient confined to bed or wheelchair

Parkinsonism
Examination findings

- Subjective - monopitch, monoloudness, reduced loudness, difficulty with initiation, articulatory imprecision, rough voice
- Endoscopic/stroboscopic – vocal fold bowing, exaggerated amplitude, impaired coordination/effort
- Acoustic – reduced dynamic range, elevated jitter and shimmer, elevated tremor
- Aerodynamic – Decreased subglottic pressure and increased airflow
- Oral motor – Masked facies

Parkinsonism
Treatment options

- Voice therapy
  - Lee Silverman Voice Therapy (LSVT – focuses on loudness, pitch variation, stamina, and re-calibration of self-feedback)
  - Prosodic intervention
  - Respiratory training
- Surgical therapy
  - Injection laryngoplasty
  - Medialization thyroplasty
- Medical/neurological therapy
  - Timing of PD medications
  - Deep Brain Stimulator (DBS)

Spasmodic dysphonia

- Hypothesized damage to basal ganglia
  - Focal dystonia
    - Adductor (strained voice with intermittent, irregular voice stoppages)
    - Abductor (weak, breathy voice with intermittent breathy breaks)
  - **Voice arrests**

Spasmodic dysphonia
Important background information

- Often gradual in onset
- Onset typically at middle age
- More common in females (Deems et al, 1997)
- Communicative stress builds in relationship to duration of symptoms
- Symptoms worsen under stressful conditions (e.g. phone)
- May co-exist with other dystonias

Adductor spasmodic dysphonia
Examination findings

- Subjective – Strangled vocal quality with voice stoppages – better with singing, whispering, falsetto
- Endoscopic/stroboscopic – sporadic hyper adduction of TVF
- Acoustic – Aperiodic segments, frequency shifts, phonatory breaks – especially mid portion of vowel (Sapienza et al 1998)
- Aerodynamic – Low airflow rate and high subglottic pressure
- Oral motor – May co-occur with blepharospasm or other dystonias

Abductor spasmodic dysphonia
Examination findings

- Subjective – Intermittent breathy breaks
- Endoscopic/stroboscopic – sporadic hyper abduction of TVF – persists during singing
- Acoustic –Elevated voice onset time, extended duration for words/sentences (Ludlow et al 1991, Edgar et al 2001)
- Aerodynamic – High airflow rate and low subglottic pressure

Differential diagnosis Spasmodic dysphonia vs. MTD

- Consistency
  - SD: minimal variation day to day, very limited potential for normal voice
  - MTD: may vary widely, may have episodes of return to normal voice
- Transitions
  - SD: difficulty with voice-voiceless transitions
  - MTD: no voice-voiceless difficulties
- Response to therapy
  - SD: little to no improvement after voice therapy
  - MTD: high potential for improvement from therapy

Adductor vs. Abductor spasmodic dysphonia

- Passages with predominantly voiced phonemes more difficult for ADDuctor SD
  - o "Early one morning a man and a woman were ambling along a one mile lane, running near rainy island avenue."
  - o Counting from 80-89
- Passages with many voice-voiceless transitions more difficulty for ABDuctor SD
  - o "He saw half a shape mystically cross a simple path in front of his sister Kathy's house."
  - o Counting from 60-69

Spasmodic dysphonia Treatment options

- Voice therapy
  - Supportive to other interventions
  - Education
  - Optimization of response to disorder
- Medical therapy
  - Botox injections
- Surgical therapy
  - Selective de-innervation/re-innervation procedure

Essential tremor

- Disorder of the central nervous system often associated with advanced age
  - Regular, involuntary muscular movement
  - Tremor absent at rest, maximal during sustained posture, present with movement (Speech/voice characteristics:)
  - Significant improvement with alcohol

Essential tremor Important background information

- Most common onset around 70 years of age
- ~50% with family history

Essential tremor Examination findings

- Subjective - rhythmic variation of pitch and/or loudness – most notable during sustained phonation
- Endoscopic/stroboscopic – normal structure and function with overlaid tremor noted most during sustained phonation
- Acoustic – 3-7Hz tremor during sustained phonation
- Aerodynamic – measures may be normal
- Oral motor – may co-exist with palatal and/or lingual tremor

Essential tremor Treatment options

- Voice therapy
- Medical therapy
  - Typically managed by neurologist
  - May include Propranolol, Diazepam, Primidone, and/or Clonazepam
    - Reduce tremor amplitude

Conclusion

- Assessment of neurogenic voice disorders requires consideration of the entire vocal tract
- Onset and progression provide vital diagnostic information
- Accurate diagnosis critical for appropriate treatment planning
- Treatment should be multidisciplinary and target the underlying neurogenic deficits when possible

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Team-Based Approach to Voice Care

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Melissa Kim, M.S., CCC-SLP

The Milton J. Dance, Jr. Head & Neck Center
The Johns Hopkins Voice Center at GBMC
Baltimore, Maryland

Saturday April 8, 2011
2:50 – 3:10pm

Interdisciplinary Team

- The management of patients with vocal pathologies is complex. All patients need access to a team of professionals with expertise in the management of vocal pathologies and state-of-art diagnostic and treatment tools for optimal vocal improvement to be realized.

Our team

- Laryngologist
- Head and Neck Surgeon
- Speech Pathologist & Voice Specialists
- Singing Teacher - Voice Clinician
- Clinical Research Associate
- Medical Assistant
- Administrative Staff Support

Interdisciplinary & Comprehensive Voice Center

- Our approach
  - A combination of …
    - Behavioral approaches
    - Medical interventions
    - Surgical options

Interdisciplinary & Comprehensive Voice Center

- Collaboration between otolaryngologists and speech pathologists employing state of the art technology such as stroboscopy, pH probe monitoring, KTP laser, vocal fold injections, voice therapy, etc., in an office-based voice clinic setting is the ideal approach to the diagnosis and treatment of vocal pathologies and optimization of patient outcomes.

ASHA Position Statement

- Performing endoscopy within SLP scope of practice
- Actual right to perform procedure state mandated, facility specific
- No specific competency checklist, only guidelines
- Where are we NOW????


Vocal Tract Visualization and Imaging: Position Statement

Update on Compliance Requirements for Medicare In-the-Room Physician Supervision

- January 21, 2011: The Centers for Medicare & Medicaid Services (CMS) determined that, effective January 1, 2011, a physician must be in the room when a speech-language pathologist performs a videostroboscopy or nasopharyngoscopy procedure (CPT 31579, 92511) under Medicare Part B.
- The decision was made as the result of a practitioner's inquiry to a CMS regional office regarding Medicare supervisory requirements.

Update on Compliance Requirements for Medicare In-the-Room Physician Supervision

CMS WEB SITE

- The new requirement is not currently available on the national CMS Web site. However, reference to the supervision requirement should be available on all Medicare Administrative Contractor (MAC) Web sites.
- An example of the supervision level display is on the Trailblazer MAC fee schedule Web site which, incidentally, can be used to request geographically adjusted fees for any locality.
  - Select Year (2011)
  - State (any)
  - Locality (any)
  - 31579 or 92511 fee information appears
  - Scroll down to "Indicators"
  - See "Physician Supervision of Diagnostic Procedures"
  - Click on question mark adjacent to "03" for a description of the 03 level of supervision: "Procedure must be performed under the personal supervision of a physician." The regulatory definition of personal supervision is "in the room."

Patient Flow

- Patient history / interview with SLP including subjective symptom indices.
- Review of medical history
- Laryngeal function studies
- Patient history / medical assessment by laryngologist and SLP
- Imaging: Laryngeal Stroboscopy
- Review study & findings with the patient
- Recommendations for medical and/or therapeutic interventions.

Case Study #1, TF

- ? Left tvf paralysis, ? RLN Injury during sx.
- Immediate vocal changes post surgery
- 57 year old male who underwent esophagectomy, jejunostomy tube, pyloroplasty, EGD, bronchoscopy 11/15/2010 for stage II adenocarcimona of the distal esophagus.
- Right lung abscess: possibly due to dysphagia, aspiration dx'd Feb 28 11
- Slight improvement in voice over the past 5 months.

Case Study #1, TF: Acoustic Analysis

- **Frequency Perturbation: (NL = <1.04%)**
  6.48% significantly exceeds normal
- **Amplitude Perturbation: (NL = <3.80%)**
  9.62% significantly exceeds normal
- **Speaking Fundamental Frequency:**
  174Hz elevated pitch [NL= 124Hz]
- **Max Phonation Range: (NL = 18-24 notes)**
  193-631Hz severely dysphonic
- **Maximum Phonation Time:** .82 seconds
- **Average Volume:** 64dB
- **Resonance:** wnl
- **Breath Support:** wnl

Case Study #1, TF

00:15:05 (34:1) –
Fully adducted position PRE INJECTION

02:34:19 (35:1) - post injection

Case Study #2, P.H.

- P.H., a 49-year-old male, presented with the complaint of a nine-month history of gradually worsening hoarseness and eventual aphonia
- Recalls laryngitis associated with URI that never improved
- Expressed a great deal of anxiety regarding his voice problems as he worked as a corporate trainer
- Had been to three previous ENTs, whom all declared him "normal"

Case Study #2, P.H.

- PMH: Hypertension, gastroesophageal reflux disease, seasonal allergies
- PSH: Rhinoplasty and hernia repair
- Medications: Norvasc, Protonix, Allegra
- Non-smoker, non-drinker
- V-RQOL: 30 (Poor)
- RSI: 31 (NL = ≤13)

Case Study #2, P.H.

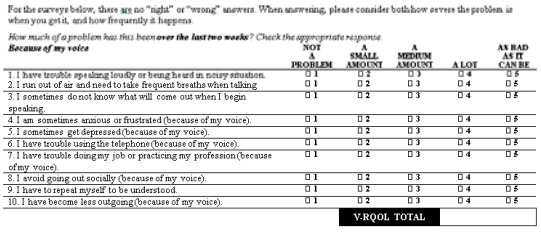
- Laryngeal stroboscopy performed by physician
- Review of findings
- Reassurance of no pathologic finding
- Diagnosis and definitive treatment of voice therapy encouraged

Case Study #2, P.H.

- SLP role
  - Assist with procedure
  - Attempt elicitation of voicing with vocal "tricks"
  - Discussion of diagnosis, etiology, and present treatment plan
  - In some cases, on-the-spot treatment possible
  - With P.H., immediate voice therapy resulted in resolution of symptoms

www.gbmc.org/voice

Patient Quality-of-Life Surveys



Patient Quality-of-Life Surveys

For the surveys below, there are no "right" or "wrong" answers. When answering, please consider both how severe the problem is when you get it, and how frequently it happens.

How much of a problem has this been ***over the last two weeks****? Check the appropriate response.*

Because of my voice	NOT A PROBLEM	A SMALL AMOUNT	A MEDIUM AMOUNT	A LOT	AS BAD AS IT CAN BE
1. I have trouble speaking loudly or being heard in noisy situation.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
2. I run out of air and need to take frequent breaths when talking	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
3. I sometimes do not know what will come out when I begin speaking.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
4. I am sometimes anxious or frustrated (because of my voice).	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
5. I sometimes get depressed (because of my voice).	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
6. I have trouble using the telephone (because of my voice).	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
7. I have trouble doing my job or practicing my profession (because of my voice).	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
8. I avoid going out socially (because of my voice).	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
9. I have to repeat myself to be understood.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
10. I have become less outgoing (because of my voice).	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
			V-RQOL TOTAL		

Patient Quality-of-Life Surveys

Within the last MONTH, *how did the following problems affect you?*

	(0=NO PROBLEM					5=SEVERE PROBLEM)
1. Hoarseness or a problem with your voice.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
2. Clearing your throat.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
3. Excess throat mucous or postnasal drip.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
4. Difficulty swallowing food, liquids, or pills.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
5. Coughing after you ate or after lying down.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
6. Breathing difficulties or choking episodes.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
7. Troublesome or annoying cough.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
8. Sensations of something sticking in your throat/lump in your throat.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
9. Heartburn, chest pain, indigestion, or stomach acid coming up.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
			RSI TOTAL			

Patient Quality-of-Life Surveys

How much of a problem has this been ***over the last two weeks?*** *Check the appropriate response.*

	(0=NO PROBLEM					5=SEVERE PROBLEM)
1. My swallowing problem has caused me to lose weight.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
2. My swallowing problem interferes with my ability to go out for meals.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
3. Swallowing liquids takes extra effort.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
4. Swallowing solids takes extra effort.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
5. Swallowing pills takes extra effort.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
6. Swallowing is painful.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
7. The pleasure of eating is affected by my swallowing.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
8. When I swallow food sticks in my throat.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
9. I cough when I eat	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
10. Swallowing is stressful.	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
				EAT-10 TOTAL		

Considerations for Voice Therapy: Pre- and Post-Operatively

What if Surgery is Recommended?

Pre-Op

- Education
  - The patient must be educated on the risks and benefits of surgery, including scar, expectations for voice rest, limited voice use after voice rest, and any other restrictions

Pre-Op

- Vocal hygiene
  - Proper vocal hygiene can reduce inflammation prior to surgery. The surgical field then becomes a truer picture of what the surgeon is dealing with.
    - Voice rest
      - Discontinuing voice overuse, misuse, and abuse
    - Reflux
      - Acid reflux medications
      - Reflux precautions
    - Hydration/humidification

Pre-Op

- Vocal facilitating techniques to decrease edema/ lesion
  - Resonant voice therapy and semi-occluded vocal tract exercises:
    - Current research (not yet peer-reviewed) is leading to speculation that the above techniques have a biological healing factor due to the relatively large-amplitude vibrations of the vocal folds, potentially causing cell deformation and a change in mechanical signaling. (Voice rest has an inherent prevention factor but does not have a healing factor.)

Pre-Op

- Instruction in post-op recommendations and facilitating techniques
  - Post-op can be a difficult time for a patient to learn new vocal habits and skills.
  - The voice will feel and sound different, especially at first.
  - The patient may not be able to rely on their ear as they are used to doing.
  - Pre-op voice therapy can prepare the patient for post-op voice use.

Post-Op

- Education/What to expect
  - Period of voice rest
  - Period of modified voice rest or conservative voice use
  - Period of hoarseness (voice may get worse before it gets better)
  - Role of voice therapy in recovery and prevention of further voice issues

Post-Op Voice Rest

- No talking and no whispering. Write, text, e-mail only.
- Avoid throat clearing or coughing.
- Stay well hydrated.
- No aspirin products or N.S.A.I.D.'S (blood thinners)
- No heavy lifting or strenuous exercise.
- If you are being treated for reflux, remember to take your medication.

Post-Op Voice *Use*

- Modified Voice Rest
  - 6 minutes per hour of voice use. NOT ALL AT ONCE! (1 minute on, 9 minutes off).
  - It is important that the patient uses his/her voice during that minute.
  - Use voice therapy exercises during that minute.
  - Do not whisper. Do not strain. Do not use a tentative voice. (Patient needs to understand what these terms mean and how they are different from healthy voicing.)
  - Avoid throat clearing/coughing.
  - Hydrate, take reflux meds, follow reflux precautions.

Post-Op Voice Therapy

- Voice quality after phonosurgery takes time to return to normal or find a "new normal"
  - Clinician's ear must be tuned to this… can't be listening for the usual cues
  - Patient instructed to rely more on how it feels than how it sounds
- Patient will likely be nervous: Anxiety can contribute to tension and breath holding
  - Relaxation exercises
  - Non-voiced structure isolation practice is appropriate (lowering larynx, lifting palate, etc.)
- Short practice sessions repeated throughout the day (5-20 minutes) until muscle strength is developed and technique becomes consistent.
- Frequent rest periods to reestablish appropriate muscle relaxation.

Post-Op

- Vocal facilitating techniques for scar minimization
  - Resonant voice therapy and semi-occluded vocal tract exercises:
    - There is speculation that these techniques have a biological healing factor due to the relatively large-amplitude vibrations, potentially causing cell deformation and a change in mechanical signaling. (Voice rest has an inherent prevention factor but doesn't have a healing factor.)
  - Glides:
    - Fosters flexibility, decreases rigidity or hypofunction. There is speculation that glides prevent scarring.

Traditional Voice Therapy

- To avoid surgery (fingers crossed)
- To treat prior to surgery (decreasing inflammation and learning new vocal habits/skills for post-op)
- To treat after surgery (preventing scar, reinforcing new vocal habits/skills)
- To prevent recurrence

Therapy Techniques

- Resonant Voice Therapy
  - Lessac Madsen Resonant Voice Therapy (LMRVT)
  - Kittie Verdolini
- Semi-occluded vocal tract exercises
  - lip trills
  - Ingo Titze
- Stemple's Vocal Function Exercises
  - sustained phonation
  - pitch glides
- Estill's False Vocal Fold Retraction and Twang

Physiologic Voice Therapy, cont'd

- Dr. J. Stemple's Vocal Function Exercises
- "A series of direct, systematic voice manipulations (exercises), similar in theory to physical therapy for the vocal folds, designed to strengthen and balance the laryngeal musculature, and to improve the efficiency of the relationship among airflow, vocal fold vibration, and supraglottic treatment of phonation." (Clinical Updates in Voice: Voice Therapy for the 21st Century, Symposium October 24, 1999)
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Role of the Singing Voice Specialist

Joanna Lott, M.A., CCC-SLP
Singing Voice Specialist

Three-Part System

- Power = respiration (breath)
- Source = phonation (vocal folds)
- Filter = resonance (vocal tract)

Vocal Athletes

- Singers are expected to be able to sing 3 octaves without breaks or noticeable changes in tone.
- Singing requires extreme precision and coordination of the three-part system.
- Subtle changes in power, source, or filter leads to:
  - changes in the color or quality of the sound
  - an increase (or decrease) in the ease of voicing
- Singers literally *tune* their voice as they sing.

Singing Styles

- Classical
- Musical theater
  - MT legit
  - MT belt
- Jazz
- Pop
- Rock
- Gospel
- Folk
- Folk-rock
- Alternative
- Country
- Choral

Styles and Bias

- Each style has its own specific aesthetic bias:
  - Classical singing requires constant vibrato with a low laryngeal position.
  - Musical theater runs the gamut regarding laryngeal height and vibrato.
  - Rock/pop/gospel: laryngeal positioning varies as does vibrato, but you'll notice vibrato happening at the onset of a note and then fading away. These styles also often seem to demand hyperfunction.
- It is also often the case that a song doesn't fit into just one category.

Classical

Pop

Demand

- High C = 1,046 collisions per second.
- Even the C one octave lower = 523 collisions
- How many times per day might one singer's vocal folds collide?

Coordinating the 3-part system

- How do you do it?
- Part One: Power
- What is it? (breath)
- How do you "support" it?
- How do you train support?
- Is there only one way?

Breath Support

- Vennard - The most efficient breath is a combination of diaphragmatic and abdominal breathing.
- Brown - Breathing exercises taught independently from tone production and linked with posture.
- McKinney - the chest should be comfortably high, the lower abdomen should be comfortably in, the upper abdomen should be free to move
- Nair - does not employ the intercostals to do the work of inhalation/exhalation
- Doscher - Train flexible antagonism between the expanded rib cage and the lowering diaphragm and contraction of the abdominal muscles for steady and controlled air flow
- Reid - "The utilitarian value of breath support as a pedagogic practice is highly suspect. It is not based upon a valid functional principle, it leads to a self-conscious awareness of the body, confuses ends with means, and overlooks that fact that in an ideal technique all of the muscular systems involved are in an equilibrium, which means that they are self supporting." (A Dictionary of Vocal Terminology, 43)
- Estill - The most effective breath solution naturally varies from task to task. Breath will change with voice quality. (Estill gets in trouble with other vocal pedagogues for describing another way to support the sound, known as "anchoring.")
- Miller - Appoggio is a system for combining and balancing muscles and organs of the trunk and neck, controlling their relationships to the supraglottal resonators, so that no exaggerated function of any one of them upsets the whole.

Vocal Training

- Some typical instruction:
  - Squeeze your uvula with your tonsils.
  - For an "open throat" the epiglottis must be held low at all times.
  - Put space *around* the tone.
  - Sing *on* the breath.
  - *Spin* the tone.
  - Send it *up and over*.
  - Put the tone in your forehead.
  - Sing from your diaphragm. (Steve Martin clip)
  - A woman should never belt. It will ruin her voice and shorten her career.

All voice teachers are not created equal

- Belting:
  - My first voice teacher told me never to belt because it would lead to nodules and ruin my voice forever.
  - My current voice teacher taught me to belt, and now it is my favorite singing style, one I often teach in my own studio.
- Larynx position:
  - Some teachers will tell you that you must maintain a low larynx position at all times while singing.
  - Others will tell you that the height of your larynx should vary depending on the tone quality you desire.
- Breath Support
  - Some will tell you that your abdominal muscles are integral to singing.
  - Others will tell you to leave your abs out of it and focus primarily on the muscles of the rib cage
  - Others still will have you grab the underside of a piano and yank up against the weight of it to "support" the sound.

- And each of these teachers is likely to tell you that the others are wrong.

Teachers Train by Modeling

"If a teacher has never mastered his or her own instrument sufficiently to be professionally useful, the student may be in real trouble when he or she models the master's voice!"

-Richard Miller

Untrained singers

- Even untrained singers often have strong ideas about how to sing and may have trouble letting go of unhealthy habits.

Treating the Vocal Athlete

- "When working with singers and other voice professionals, our expectations of normal must be heightened, and stricter criteria must be used to assess these patients." *R. T. Sataloff*
- Goal: Not just adequate voice, but excellent voice.
- Correction of minor technical faults required.

Evaluating the Vocal Athlete

- Genre of singing (rock, pop, classical, musical theater, gospel, etc.)
- Voice lessons
- Career goals
- Upcoming auditions/performances
- Typical warm-up/cool-down routine
- Frequency of practice
- Acid reflux – risk factors, symptoms, diagnosis, treatments
- Job in addition to singing – does it require voice use

Vocal abuse checklist

- Sataloff's *Professional Voice: The Science and Art of Clinical Care*, Vol. 3, Appendix VI
  - Talking too much, too loudly, too rapidly
  - Talking over noise
  - Exposure to dust, fumes, secondary smoke, dry air, second-hand smoke
  - Inadequate sleep
  - Lack of hydration
  - Use of mouthwash
  - Use of asthma inhalers

Evaluating the Vocal Athlete

- Objective/Acoustic Evaluation
- Subjective Evaluation
  - Respiration
  - Posture
  - Oral Motor Exam
  - Voice Quality

Singing Evaluation

- Have the patient demonstrate singing. Look for:
  - Tension
  - Breath support/Anchoring of sound
  - Energy vs. Effort
  - Tongue retraction
  - Easily fatigue or hoarse after singing
  - Posterior vs. Oral Tone Focus
  - Difficulties through the passagio
  - Difficulties at lowest or highest pitches (loss of range)

Rehabilitating the Vocal Athlete

- Focusing on rebalancing three-part system
  - changes in one function will produce subtle, or not so subtle, changes in the rest of the system
- Voice Therapy techniques are designed to "improve the efficiency of the relationship among airflow, vocal fold vibration and supraglottic treatment of phonation."
- J. Stemple's description of Vocal Function Exercises

Techniques (some examples)

- Vocal Function Exercises – a series of voice exercises designed to strengthen and balance the muscles of the larynx.
- Resonant Voice Therapy – focuses on resonance (filter), but in accessing/achieving this forward resonance, power and source are affected (chicken/egg)
- Jo Estill – Estill Voice Training – focus on isolating structures of the vocal mechanism and then combining the structures' functions to create voice qualities

Speaking voice

- The speaking voice can't be neglected.
- Singers speak as much as (and probably more than) they sing.
- Often singers don't carry their knowledge of vocal technique into their habitual speaking voice and must be taught to do so.

Carry-over

- Emphasize carryover into everyday speech and professional activities.
- Remind the patient that:
  - Practicing exercises will NOT automatically make your voice better
  - Exercises are only practice for what they should be doing all the time.

Carry-over exercises

- Reading
  - Sentences
  - Paragraphs
- Spontaneous speech
  - Short answers to questions
  - Longer answers to questions
  - Rehearsed conversation (with repetitions)
  - Unrehearsed conversation
  - Self-monitoring and self-correction

Post-op Voice Therapy

- Can I sing yet? Can I sing yet?
  - Post-op therapy is much like regular voice therapy with special attention paid to amount of voice use, fatigue, and old habits. This is where the importance of pre-op therapy (when possible) becomes apparent.

Can I Sing Yet?

- Yes, you can sing. If:
  - Surgeon and voice therapist agree
  - Patient:
    - Has developed awareness of voice use
      - Can use voice in moderation and knows when to stop
      - Recognizes unhealthy voice use and knows how to correct it
    - Is a responsible patient
      - Attends voice therapy and does homework
      - Shows up for follow-up videos with surgeon

Singing Exercises to start with…

- Estill's Siren (glides on "ng")
- Verdolini's Resonant Voice Therapy (humming, chanting, messe di voce with frontal tone focus)
- Glides and lip trills

Things to Remember

- Voice quality after phonosurgery takes time to return to normal or find a "new normal"
  - Clinician's ear must be tuned to this… can't be listening for the usual cues
  - Patient instructed to rely more on how it feels than how it sounds
- Singers will likely be nervous: Anxiety can contribute to tension and breath holding
  - Relaxation exercises
  - Non-voiced structure isolation practice is appropriate (lowering larynx, lifting palate, etc.)

Practice and rest

- Short sessions repeated throughout the day (5-20 minutes) until muscle strength is developed and technique becomes consistent.
- Frequent rest periods to reestablish appropriate muscle relaxation.
- Range limited by patient's ability to produce note without inappropriate tension.

Vocal Function Exercises

ALL EXERCISES SHOULD BE DONE TWO TIMES EACH, TWO TIMES A DAY!

EXERCISES

1. **Warm-Up** Hold the vowel "e" as long as possible on the musical note F. The sound should be made quietly. Take a good supported breath and project your airflow nasally by adding a "y" to the start of the sound. The area in the front of the face should vibrate slightly. Use your fingers to feel the resonation. Goal = _____ seconds.
2. **Stretching** Glide from your lowest note to your highest note on the word "knoll," a lip flutter, or a tongue roll. The sound should be made quietly. Continue the sound even if your voice breaks. Goal = no voice breaks.
3. **Contracting** Glide from a comfortable high note to your lowest note on the word "knoll," a lip flutter, or a tongue roll. The sound should be made quietly. Continue the sound even if your voice breaks. Goal = no voice breaks.
4. **Power** Hold the word */oh/* ("old" without the "d") for as long as possible on the musical notes C-D-E-F-G. You may blow out silently before starting the sound. The sound should be made quietly. Check your sound by placing your index finger to your lips (like a "sshh") and listening for the "buzz." Goal = _____ seconds.

RVT

- Basic Training Gesture
- "Take a deep breath and sustain "molm-molm-molm…" on a comfortable pitch. Notice the vibrations in the front of the face during easy voicing. Imagine an inverted megaphone and focus your sound at the narrow end. Assign a number to the effort level you are using to produce the sound; reduce this by half; reduce by half again."

Estill

- Figures/Qualities that can be used for voice therapy (for singers or non-singers) include:
  - Twang/narrow AES (can be thought of as "over the top RVT)
  - Sob quality
  - Both of these techniques encourage a barely adducted vocal fold posture (or in cases of unilateral paresis, can enhance TVF closure), while allowing for ease at the level of the TVFs
  - False Vocal Fold retraction
  - Effort levels

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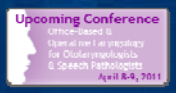
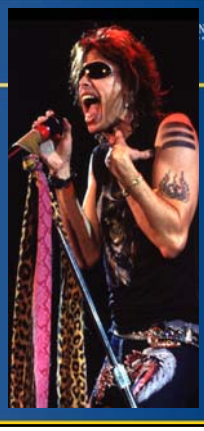
Evolution of Contemporary Technique

Laryngology in the OR
April 8, 2011



JOHNS HOPKINS MEDICINE

Lee M. Akst, MD Director, Johns Hopkins Voice Center



Why?

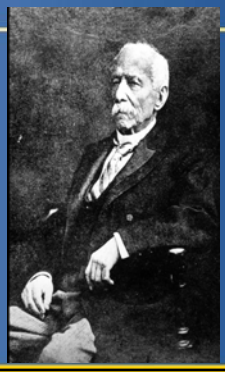
- Know where you've been to know where you're going
- Some important themes carry through:
  1. You've got to see it to operate upon it
  2. The better you see it, the better the operation you can perform
  3. Precision counts

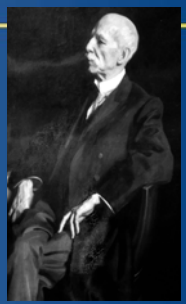
Mirror Laryngoscopy

- Levret 1743 – mirrors to visualize polyps in the "nostrils, throat, ears, and other parts"
- Bozzini 1807 "lichtlieter" – cannula with candles; certainly used to visualize anatomy, but ? larynx
- Babington 1829 glottiscope – oblong mirror held against palate, saw upper larynx; but didn't describe TVC motion

Bozzini, arch.assn-ama.org

Manuel Garcia – 1854

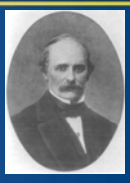




John Singer Sargent.
Rhode Island School of Design.

"The Turckish War"

- Ludwig Turck, neurologist, Vienna
  - 1857, used reflected sunlight
  - When sunlight became scarce, loaned equipment to….
- Johann Czermak, physiologist, Budapest
  - Added fenestrated mirror for physicianm, artificial lightsource
  - 1858 publication credited Turck
  - Later publications did not → the resulting public fued helped publicize laryngoscopy



Wikipedia x2

Morell Mackenzie, the "Father of British Laryngology"

- 1859 – Studied under Czermak (21 yo)
- 1863 – RCS Jackson Prize, "The Pathology and Treatment of Laryngeal Disease"
- 1865 text, *The Use of the Laryngoscope in Diseases of the Throat*
- 1871 treatise, *Growths of the Larynx*

Wikipedia

Morell Mackenzie & Crown Prince Frederick, 1887

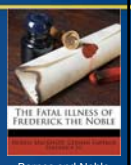
Wikipedia

Sciencemuseum.org.uk

- Frederick of Germany is married to Queen Victoria's eldest daughter; when he has chronic hoarseness, Mackenzie consulted
- Mirror exam reveals irregular vocal folds
- Mirror-guided biopsy
  - Missed the diagnosis – Virchow thought cancer started deep and eroded superficially, rather than thinking it was a disease of epithelium
- Without diagnosis, Mackenzie refused to recommend laryngectomy
- Crown Prince (then Emperor) dies, despite palliative tracheotomy, within the year

The Legacy

- There are mumbles of criticism, which Mackenzie refutes
  - Though his actions were not considered unethical, that he wrote a book (to a lay audience!) was
  - Resigns from Royal College
- The irony – not having TL may have prolonged the Prince's life; average life expectancy at that time post TL was 4 months
- Enduring question: Did manipulation of the tissue create malignant degeneration?
  - This slowed adoption of interventional laryngology



Barnes and Noble

Mirror laryngoscopy in the US

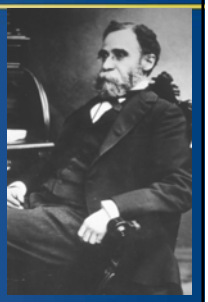
- Ernst Krackowizer was the first, in 1858
- Popularized by Louis Elsberg (New York) and Jacob Solis-Cohen (Philadelphia)
  - Elsberg: "Laryngoscopical Surgery" presented to AMA in 1865
  - Solis-Cohen: starting teaching laryngoscopy in 1866 and became first academic laryngologist, Jefferson 1869
- Then Frederick Irving Knight – Harvard 1870

Mirror Laryngoscopy

Jacob Solis-Cohen, 1868

Why does this matter?

- Elsberg, Solis-Cohen, and Knight lead the formation of the ALA in 1879
  - They then serve as first 3 presidents
- *American Archives of Laryngology*, 1880-4
- *The Laryngoscope*, 1896-



Jacob Solis-Cohen; College of Physicians, Philadelphia

Indirect Operative Laryngoscopy

- 1859, Stoerk – laryngoscopically controlled application of silver nitrate
  - Main laryngeal pathology of 19th century was membranous obstruction (diptheria)
  - Cigarettes were not mass produced until the 20th century; laryngeal cancer was a disease of the privileged
- 1860, Lewin – caustic application, and also partial excision of tumors
- 1865, Sands – transoral biopsy, then transcervical excision

Indirect Operative Laryngoscopy

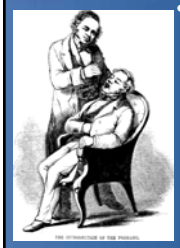
- Grows rapidly in 1860's, 1870's
- 1886, Fraenkel – mirror-guided resection as sole treatment for early glottic cancer
  - Recurrence required repeat excision x5
  - Ultimately required neck dissection
  - Survival >5 years from diagnosis
- As advanced as mirror-guided surgery became, eventually supplanted by direct laryngoscopy

Direct Laryngoscopy

- First described 1852, by Horace Green
  - Removed laryngeal polyp from an 11 yo boy
  - Used a spatula to depress the tongue, see the epiglottis
  - With cough, large laryngeal polyp was viewed; grabbed with hook and then transected at pedicle

Green. *Treatise on Diseases of the Air Passages (1846)*

Direct Laryngoscopy



ABEA.net

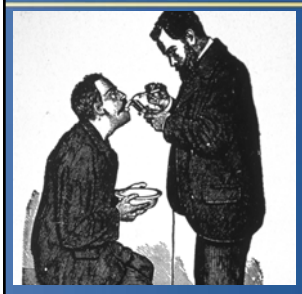
- Had been using whale probang to deliver caustics to membranous laryngeal obstruction even in pre-laryngoscoic era (1840s)
  - Was not believed at first
  - He then proved it possible in patient with a tracheotomy
- ALA: "Father of American Laryngology"

ABEA.net

Direct Laryngoscopy

- Following Green 1852, it was largely ignored for 40+ years
  - Seemed possible only in cephalad pediatric larynx
  - Depended on ambient light
  - Was limited in absence of anesthesia
- Indirect mirror laryngoscopy seemed the better option

Alfred Kirstein – 1895



- Electrical illumination
- Cocaine
- "Autoscopy"

Stroboscopy

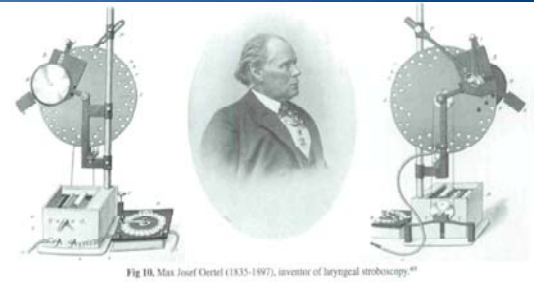
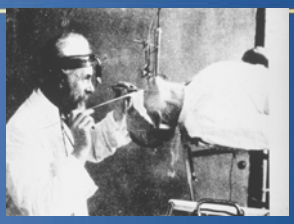
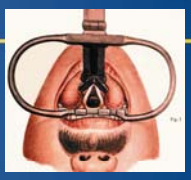


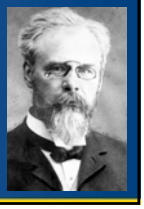
Fig 10. Max Josef Oertel (1835-1897), inventor of laryngeal stroboscopy.[49]

Oertel M. Arch Laryngol Rhinol 1895;3:1-16.
From Zeitels et al. Ann ORL 2008; 117 Suppl 199:1-24.

Gustav Killian





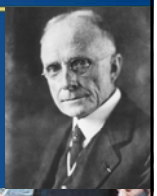


- Witnessed Kirstein, then focused on improving direct laryngoscopy
- Refined laryngoscopy spatulas
- Invented suspension laryngoscopy, for anatomic illustration

Chevalier Jackson – early 21st century

Chevalier Jackson

- First textbook on rigid endoscopy of the upper aerodigestive tract, 1907
  - Dedicated to Killian
- Separating, tubular laryngoscope
- Distal rather than proximal illumination
- Human assistants instead of suspension
  - Had to hold laryngoscope with one hand, operate with the other
  - Transferred "sniffing" position to neck flexion, head extension



Direct Operative Laryngoscopy

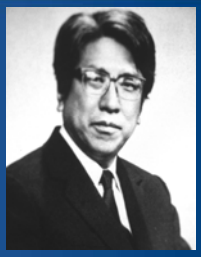
- Put this in perspective: *Direct laryngoscopy, stroboscopy, suspension laryngoscopy, distal illumination ALL were described within 15 years of one another*
- 1911, Brunings – paraffin injection
- 1915, Lynch – en bloc endoscopic for resection early neoplasia
- Etc, etc, etc . . .

Direct Operative Laryngoscopy the 1960s

- Enhanced precision
- 1960: Intubation during laryngeal surgery
  - Initial DL for intubation for general anesthesia was 1910, but not used for laryngeal surgery
- 1962: Microlaryngscopy, Jako and Kleinsasser
- Late 1960's: CO_2 laser, Jako, Strong, and Vaughan

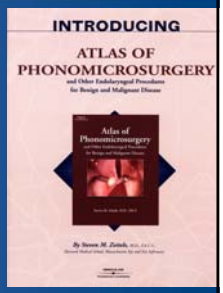
Geza Jako, courtesy of SMZ

Physiology – the 1970s



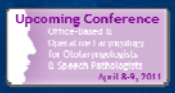
- Hirano describes the layered microarchitecture of the vocal fold
- Reintroduces "cover-body" model of vocal physiology
- Leads to emphasis on preservation of superficial lamina propria
- Which leads us from evolution to principles….

Today



Medications and the Voice: An Overall Review

Laryngology in the OR
April 8, 2011



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Lee M. Akst, MD Director, Johns Hopkins Voice Center

Vocal Health

- "Healthy" = your vocal performance can meet your vocal expectations
  - Professional
  - Performing
  - Social
  - Teaching
    - Special expectations
    - Special challenges
  - Consider the environment of classrooms and auditoriums
  - Acoustics, irritants, audience, etc.

Vocal Health

- Decrease inflammation
  - Style
  - Spending vocal "capital"
  - Avoid vocal abuse
  - Limit reflux
- Optimize efficiency
  - ***Technique***

Vocal Health

- Maintain lubrication
  - Hydration
  - Humidification
  - Nasal saline spray
  - *Beware of medications*

Medications and the Voice

- Most medications that effect the voice do so by drying the larynx
  - Dry = less lubrication, thicker secretions
  - Dry = effortful, rough voice with early fatigue; occasional diplophonia; "buzz" in voice
    - Even in normal volunteers

Medications and the Voice

- Other topics:
- Hormone effects
- Increased risk of hemorrhage
- Inflammatory mediators
- Role of PPI

Drying: Medications

- Antihistamines (benadryl, claritin, allegra, etc.)
- Decongestants (sudafed, afrin, etc.)
- Antidepressants (prozac, zoloft, elavil, etc.)
- Anticholinergics (detrol, etc.)
- Diuretics

What to do about drying?

- Risks / Benefits
  - It may be worth it to take these, but be aware of potential dryness or vocal cord irritation
- Seek the least drying version which is effective for the patient
  - Claritin < Allegra < Zyrtec < Benadryl
    - Topical steroid spray may be better yet
  - Without sudafed < with sudafed
- Replace moisture as possible
  - Hydration
  - Humidification
  - Nasal saline spray

Hormone effects

- Effects can be unpredictable
- *Some* women are effected by hormonal fluctuations during menstrual cycle
  - Estrogen → fluid retention → vocal fold edema → lower pitch, effortful voice, loss of high notes
    - Diuretics won't work – the edema is protein-bound, not free water
  - Oral contraceptives, HRT may create same effects
  - Of course, HRT *helps* some women who otherwise experience deterioration in their voices with menopause
- In a female singer who is sensitive to these effects, awareness and planning are key

Hormone effects

- Speaking of deep voice….
  - Hypothyroidism → myxedema
  - Exogenous testosterone and other androgens may deepen voice
    - Perhaps permanently

Vocal Fold Hemorrhage

- Risk Factors:
  - Laryngeal trauma
  - Phonotrauma
  - *Aspirin, NSAIDs*
  - *Anticoagulants*
  - *Hormone imbalance*
- Blood slowly resorbs
- Can promote long-term scar

Johns Hopkins Voice Center, GBMC.com

Inflammation

- Steroid inhalers create a direct irritant effect
  - It's generally the propellent, not the steroid
- Also create risk for oral thrush, laryngeal candidiasis
- In patients who need inhalers, poor lung function is itself typically a cause of poor voice

Inflammation

- Oral steroids
  - Can reduce laryngeal inflammation
  - "The show must go on!"
  - However, increased risk for vocal cord hemorrhage

Reflux

- Acid injury of the vocal cords is common
  - Hoarseness
  - Throat irritation, phlegm sensation, coughing, clearing
- Diet: caffeine, carbonation, alcohol, tomato/citrus
- Medications: PPIs, H2 antagonists, antacids

PPIs work!

- Response to empiric PPI should confirm diagnosis
- Multiple studies show statistical improvement in symptoms, signs of LPR
  Karkos, Wilson. Laryngoscope 116:144-8, 2006
- BID therapy > qD therapy, 4 months > 2 months
  Park et al. Laryngoscope 115:1230-8, 2005
- Jitter, shimmer, and NHR improved over baseline by 1-2 months with treatment, and improvement is maintained at 3-4 months
  Jin et al. Laryngoscope 118: 938-41, 2008

PPIs don't work!

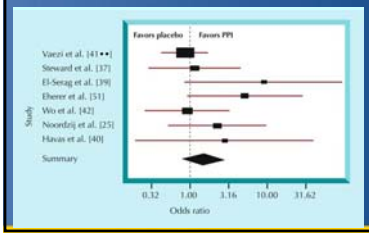
- *However*, many randomized controlled trials with placebo controls don't show a difference
  Karkos, Wilson. Laryngoscope 116:144-8, 2006
- Most symptoms may improve over time, even in placebo group
  Noordzij et al. Laryngoscope 112:2192-5, 2002
- Acoustic abnormalities did not change significantly with PPI therapy
  Hamdan et al. Acta Otolaryngol 121:868-72, 2001

Treatment

Proton Pump Inhibitor Therapy for Suspected GERD-Related Chronic Laryngitis: A Meta-Analysis of Randomized Controlled Trials

Mohammed A. Qadeer, M.D.,[1] Christopher O. Phillips, M.D., M.P.H.,[2,3] A. Rocio Lopez, M.S., M.P.H.,[3] David L. Steward, M.D.,[4] J. Pieter Noordzij, M.D.,[5] John M. Wo, M.D.,[6] Maria Suurna, M.D.,[4] Thomas Havas, M.D.,[7] Colin W. Howden, M.D.,[8] and Michael F. Vaezi, M.D., Ph.D., M.Sepi.[9]

Am J Gastroent 2006;101:2646–2654



- The good news: empiric treatment *might* be more effective clinically than placebo

Treatment

- Bnews: PPI only fix voice sometimes
  - Probably depends on whether reflux is actually the cause of the voice problem
  - Many patients with functional dysphonia try PPI without success
- Worse news: empiric treatment is not without side effects

Treatment – Side Effects

- Limits calcium absorption
  - Ostepenia
  - Hip fracture
- Increases pneumonia risk
  - (Real risk may be reflux itself)
- Decreases plavix efficacy

Treatment – Side Effects

Long-term Proton Pump Inhibitor Therapy and Risk of Hip Fracture

Yu-Xiao Yang, MD, MSCE
James D. Lewis, MD, MSCE
Solomon Epstein, MD
David C. Metz, MD

Context Proton pump inhibitors (PPIs) may interfere with calcium absorption through induction of hypochlorhydria but they also may reduce bone resorption through inhibition of osteoclastic vacuolar proton pumps.

Objective To determine the association between PPI therapy and risk of hip fracture.

Design, Setting, and Patients A nested case-control study was conducted using the General Practice Research Database (1987-2003), which contains information on patients in the United Kingdom. The study cohort consisted of users of PPI therapy and nonusers of acid suppression drugs who were older than 50 years. Cases included all patients with an incident hip fracture. Controls were selected using incidence density sampling, matched for sex, index date, year of birth, and both calendar period and duration of up-to-standard follow-up before the index date. For comparison purposes, a similar nested case-control analysis for histamine 2 receptor antagonists was performed.

Main Outcome Measure The risk of hip fractures associated with PPI use.

Results There were 13 556 hip fracture cases and 135 386 controls. The adjusted odds ratio (AOR) for hip fracture associated with more than 1 year of PPI therapy was 1.44 (95% confidence interval [CI], 1.30-1.59). The risk of hip fracture was significantly increased among patients prescribed long-term high-dose PPIs (AOR, 2.65; 95% CI, 1.80-3.90; $P<.001$). The strength of the association increased with increasing duration of PPI therapy (AOR for 1 year, 1.22 [95% CI, 1.15-1.30]; 2 years, 1.41 [95% CI, 1.28-1.56]; 3 years, 1.54 [95% CI, 1.37-1.73]; and 4 years, 1.59 [95% CI, 1.39-1.80]; $P<.001$ for all comparisons).

Conclusion Long-term PPI therapy, particularly at high doses, is associated with an increased risk of hip fracture.

JAMA. 2006;296:2947-2953 www.jama.com

Treatment – Side Effects

Proton-Pump Inhibitor Therapy Induces Acid-Related Symptoms in Healthy Volunteers After Withdrawal of Therapy

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Gastroenterology 2009;137:80–87

- PPI may *cause* reflux in normal volunteers → Rebound Acid Hypersecretion (RAHS)
- 120 healthy volunteers: Placebo vs Nexium for 8 weeks
- Then 4 weeks of placebo, with reporting of symptoms
- 44% Nexium group vs 15% Placebo with ≥ 1 symptom
- Statistically significant for each timepoint, week 9 - 12

Treatment – Conclusions

GASTROENTEROLOGY 2008;135:1383–1391

AGA INSTITUTE

American Gastroenterological Association Medical Position Statement on the Management of Gastroesophageal Reflux Disease

A. What Is the Best Initial Management for Patients With Suspected Extraesophageal Reflux Syndromes (Asthma, Laryngitis, Cough)? What Are the Unique Management Considerations With Each? What Is the Appropriate Dose and Course of Antisecretory Therapy in Each?

Grade B: recommended with fair evidence that it improves important outcomes

1. Acute or maintenance therapy with once- or twice-daily PPIs (or H_2RAs) for patients with a suspected extraesophageal GERD syndrome (laryngitis, asthma) with a concomitant esophageal GERD syndrome.

Grade D: recommend against, fair evidence that it is ineffective or harms outweigh benefits

1. Once- or twice-daily PPIs (or H_2RAs) for acute treatment of patients with potential extraesophageal GERD syndromes (laryngitis, asthma) in the absence of a concomitant esophageal GERD syndrome.

Grade Insuff: no recommendation, insufficient evidence to recommend for or against

1. Once- or twice-daily PPIs for patients with suspected reflux cough syndrome.

- Grade B: Treat EER *if* accompanied by GERD
- Grade D: "Recommend against, fair evidence that it is ineffective or harms outweigh benefits" for potential EER in absence of GERD
- Return to paradigm of models . . .

Treatment – Notes

- Why do they say this?
- Recommendations have GI perspective
  - No Otolaryngologists on the panel
  - "Suspected Extra-esophageal GERD syndromes"

Chronic cough, laryngitis, and asthma have an established association with GERD on the basis of population-based studies. However, cough, laryngitis, and asthma have a multitude of potential etiologies other than GERD, making them nonspecific for GERD. Furthermore, the causal relationship of GERD with these nonspecific syndromes in the absence of a concomitant esophageal GERD syndrome remains controversial and unproven. The only randomized controlled trials showing a treatment effect for GERD therapies in these syndromes were in patients with esophageal GERD syndromes in addition to either laryngitis or asthma. Hence, existing evidence supports the following: (1) the association between these syndromes and GERD, (2) the rarity of extraesophageal GERD syndromes without concomitant esophageal symptoms or findings, (3) that suspected extraesophageal GERD syndromes are usually multifactorial, and (4) that data substantiating benefit from the treatment of reflux for the extraesophageal syndromes are very weak. Furthermore, clinical predictors implicating GERD in the extraesophageal syndromes have proven elusive, and the premature adoption of flawed diagnostic criteria has likely resulted in the overdiagnosis of extra esophageal GERD syndromes.

So, where does this leave us?

- Dilemma: knowledge vs practice management
- Reality: we need to do something

In summary, patients with suspected extraesophageal GERD syndromes may have GERD as a contributing etiology but rarely as the sole cause. However, the increasing incrimination of GERD as an etiologic factor along with the lack of accurate confirmatory diagnostic tests has resulted in widespread overdiagnosis and overtreatment of these conditions. Nonetheless, empirical therapy with twice-daily PPIs for 2 months remains a pragmatic clinical strategy for subsets of these patients if they have a concomitant esophageal GERD syndrome. Failing such a trial, etiologies other than GERD should be explored.

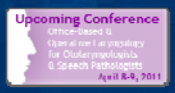
(Who feels good about this?)

Take Home Tips – General Hygiene

- Limit screaming or shouting, which stress the vocal cords.
- Drink plenty of water or other non-caffeinated, non-alcoholic beverages. Aim for six-to-eight 8-ounce glasses of water daily.
- Don't smoke, and avoid smoky, dusty or dry environments which might irritate the vocal cords.
- Avoid excessive throat clearing or coughing – if you need clear a sensation of thick mucous, try taking sips of water instead.
- Use plenty of breath support while speaking or singing, as a strong, clear voice begins with airflow from the lungs.
- Recognize high-risk vocal situations. When there is background noise, you might not realize just how loudly you are speaking.
- Listen to your voice: If it begins to sound rough or feel effortful, your vocal cords may be getting inflamed.
- Rest your voice when necessary.

Vocal Fold Injection: Techniques and Injectables

Laryngeal Procedures in the Office
April 9, 2011



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Lee M. Akst, MD Director, Johns Hopkins Voice Center

Outline

- ***Where*** – office vs. operating room
- ***Why*** – the reasons to do an injection
- ***What*** – the injectables
- ***How*** – the techniques

Office-Based Injection – Where

- Office
  - Schedule at your convenience
  - Topical / local anesthesia
  - Several approaches
  - Procedure: 10-15 minutes
  - Set-up, turnover, etc. = 30 minutes total
  - Patient time = 30 minutes
- Operating Room
  - Schedule when you have OR time available
  - General anesthesia
  - Via direct laryngoscopy
  - Procedure: 10-15 minutes
  - Set-up, turnover, etc. = 90 minutes total
  - Patient time = 4-5 hours

Other benefits

- "Financially effective"
  - Average costs - $2505 OR vs. $496 office

    Bove et al. Laryngoscope. 2007 Feb;117(2):226-30
- Anesthesia morbidity greatly decreased
- Ability to judge endpoint of medialization
  - Awake patient can phonate, with stepwise injection
  - Awake patient can demonstrate degree of contralateral abduction

Office-Based Injection – Why

- To improve closure, decrease glottal insufficiency
- Unilateral vocal fold paralysis
  - Improve voice – less breathiness, less effort, better projection
  - Improve swallowing
  - Strengthen cough
- Vocal fold paresis with incomplete or effortful closure
- Presbylaryngis with incomplete closure

Office-Based Injection – Why

- Contour defect (post-resection)
- Steroid – scar, nodules, granuloma
- Botox – spasmodic dysphonia
- Cidofovir – RRP
- New biologics – scar, lost pliability

What to inject

- "What" depends on "why"
- Specific indications for steroid, cidofovir, botox
- Choose concentration appropriate for vocal folds
- Steroid
  - Preservative free dexamethasone 10 mg/cc
  - Methylprednisolone 40 mg/cc
- Cidofovir – concern over inflammatory effect ?
- Botox – defer to Dr. Fletcher

What to inject

- Controversy for medialization injectables
  - Ask a different laryngologist, get a different answer
- Perfect injectable
  - Biocompatible
  - Easy to handle
  - Low (or no) donor site morbidity
  - Easily available
  - Predictable results
  - Vibratory characteristics???

What to inject - Permanent

- Teflon
  - Arnold 1962
  - Concern over long-term granuloma
- Radiesse Voice
  - Calcium hydroxylapatite microspheres, 25 – 45 µm
  - Gel-based carrier of water, glycerin, and sodium carboxymethylcellulose – overinject by ~20%
  - Available testing shows results calcium particles reabsorb between 1 – 2 years

What to inject - Temporary

- Gelfoam
  - 4-6 weeks
  - Off market(?)
  - Requires preparation and requires 18g needle
- Collagen
  - Bovine (zyplast) – requires skin testing
  - Autologous – requires skin harvest and processing
  - 3-6 months

What to inject - Temporary

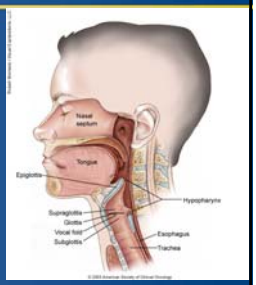
- Cymetra
  - Micronized acellular human cadaveric dermis
  - ~3 months; may persist long-term unpredictably
  - Requires processing
- Fat
  - Donor site morbidity
  - Processing (improved with lipivage)
  - Donor site morbidity – general anesthesia?
  - Unpredictable duration

What to inject - Temporary

- Radiesse voice gel
  - Water, glycerin, sodium carboxymethylcellulose
- Restylane
  - Cross-linked hyaluronic acid
- "Off-the-shelf"
- Biocompatible
- Good fluid dynamics
- ~1.5 – 2.5 months
- Vibratory characteristics???

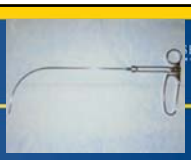
How to inject

- Two aspects
  - Visualization
  - Injection
- Visualization
  - Monitor
  - Transoral – rigid telescope
  - Transnasal – flexible scope



How to inject

- Needle placement
  - Transoral
  - Thyrohyoid membrane
  - Cricothyroid membrane
  - Trans-thyroid cartilage
  - Via flexible scope
  - (Direct laryngoscopy)



How to inject - Anesthesia

- Transoral visualization, transoral injection
  - Benzocaine to oropharynx
  - 4% lidocaine to TVC from transoral injection system
- Transnasal visualization
  - Topical anesthetic, decongestant to nose (my clinic – ponticaine with oxymetazoline)
  - 4% lidocaine to TVC via flexible scope or cannula – or –
  - Topical lidocaine via thyrohyoid needle

How to inject - Anesthesia

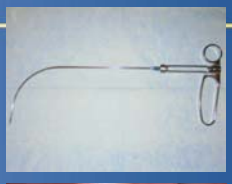
- Transcervical injection
  - 1% lidocaine with 1:100,000 epi to skin, needle track
- Anesthesia pearl – careful balance:
  - Enough to be comfortable
  - Not so much that there is difficulty handling secretions – this increases gag
  - Patients with TVC paralysis often have some difficulty with secretions to begin with

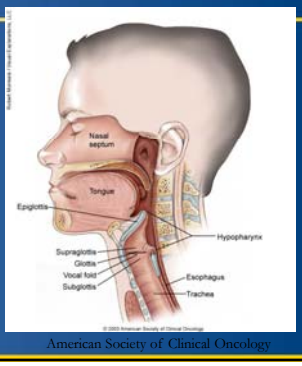
Risks and Benefits

- Benefits – already discussed
- Risk of discomfort
- Risk of bleeding
  - Down airway – coughing
  - In TVC – expanding hematoma can compromise airway
- Airway compromise
- Inadequate injection, inability to complete injection
- Infection – 1 case report, with cymetra

Zapanta, Bielamowicz. Laryngoscope. 2004;114:1522-4

Transoral Injection





American Society of Clinical Oncology

Transoral Injection

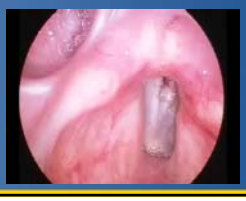
- Precision: good
- Tolerance: patient-dependent
- Learning curve: if already doing rigid strobe, then transoral injection is fairly easily learned
- Set-up/Equipment: need rigid scope; *no need for second person*
- Pro/con overall: Ability to do it without an assistant, precision of injection make it my preferred technique for patients who tolerate it

Transoral Injection

Transoral Injection

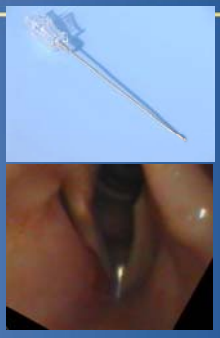
Injection Pearls

- Overclosure anteriorly = strain, and can limit injection
- Hyperfunction
- Inflammation may reduce vibration after injection



Transoral Injection - Steroid

Thyrohyoid Injection



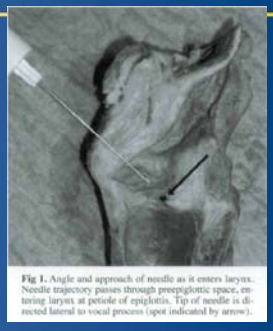


Fig 1. Angle and approach of needle as it enters larynx. Needle trajectory passes through preepiglottic space, entering larynx at petiole of epiglottis. Tip of needle is directed lateral to vocal process (spot indicated by arrow).

Amin MR. Ann Otol Rhinol Laryngol. 2006;115(9):699-702

Thyrohyoid Injection

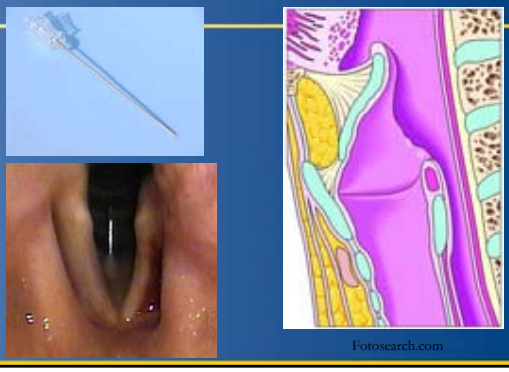
- Precision: fair; see needle enter, but angle difficult
- Tolerance: good
- Learning curve: angle of injection is difficult
- Set-up/Equipment: no special equipment, but requires a second person to pass the scope
- Pro/con overall: get to see needle enter the cord, which makes this a valuable technique for patients who cannot tolerate oral injection; limited by need for a second person

Thyrohyoid Injection

Courtesy of Adam Klein, Emory Voice Center

Thyrohyoid Injection

Cricothyroid Injection



Fotosearch.com

Cricothyroid Injection

- Precision: limited, cannot see needle
- Tolerance: good
- Learning curve: similar to Botox approach, but with patient supine
- Set-up/Equipment: no special equipment, but requires a second person to pass the scope
- Pro/con overall: Prefer thyrohyoid approach because the needle is visible

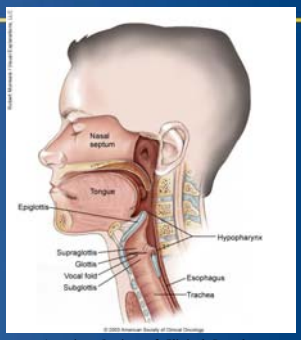
Cricothyroid Injection

Courtesy of Seth Dailey, University of Wisconsin

Cricotyhroid Injection

Courtesy of Michael Johns, Emory Voice Center

Transnasal Injection



American Society of Clinical Oncology

Transnasal Injection

- Described by Harry Hoffman, University of Iowa

  Trask et al. Laryngoscope. 2005 Dec;115(12):2262-65
- Needle: 23 or 25g, 4.0 mm tip
- Sheath 200 cm long, 1.8 mm diameter
- Cymetra: Dilute 2.3 cc (not 1.7 cc) to pass through needle and accommodate the 1.4 cc deadspace
- Zyderm: load 2 1.0 cc syringes, and deliver 0.4 cc
- Saline at the interface decreases waste
- New needle coming?

Transnasal Injection

- Precision: fair-to-good
- Tolerance: excellent
- Learning curve: small – we all pass scopes
- Set-up/Equipment: sclerotherapy flexible needle, scope with an instrument channel, an assistant to manage the needle
- Pro/con overall: Well tolerated and technically less complex than other techniques; 'dead space' in the needle leads to wasted injectate; viscosity can be an issue

Transnasal Injection

Courtesy of Steven Zeitels, MGH Center for Laryngeal Surgery

Lessons

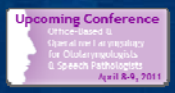
- Too much anesthesia = more secretions
- Aim laterally within the vocal fold for medialization, and medially for steroid
- Measure amount needed during injection
  - Assess closure
  - Assess airway patency
  - Avoid over-closure anteriorly as possible

Lessons

- It's easy
- Don't expect return of mucosal wave right away
- Supraglottic hyperfunction may persist – voice therapy can help

Pulsed Laser Use in the Office

Laryngeal Procedures in the Office
April 9, 2011



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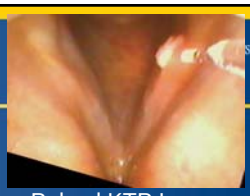
Lee M. Akst, MD Director, Johns Hopkins Voice Center

Medical Advances

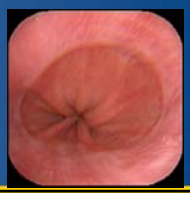
- To improve treatment outcomes
  - In laryngology, move from office to OR was driven by need for increased precision
- To reduce treatment morbidity
- To improve patient safety and comfort
- To minimize costs of treatment, or improve efficiency of care
  - Move from OR back to office when appropriate

Innovations

Office-based injection



Pulsed KTP Laser Photoangiolysis



Transnasal Esophagoscopy

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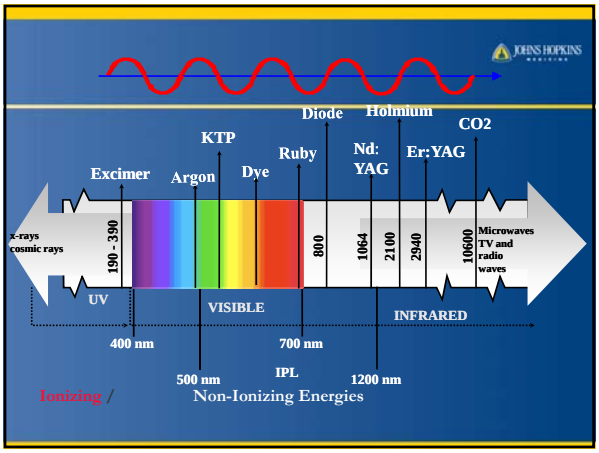
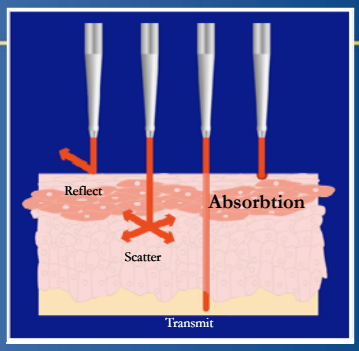
Lasers in General



Common Medical Lasers

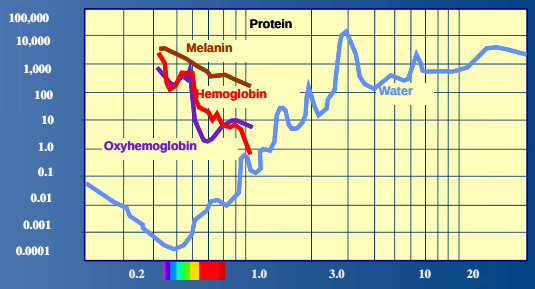
Medium	Spectrum	Wavelength
CO2	Far Infrared	10,600 nm (10.6m)
Er:YAG	Mid Infrared	2940 nm (2.1m)
Ho:YAG	Mid Infrared	2,100 nm (2.1m)
Nd:YAG	Near Infrared	1,064 nm (1.06m)
Diode Lasers	Visible & NIR	~530 - 1100nm
Alexandrite	Near Infrared	755 nm
Ruby	Deep Red	694 nm
Krypton	Red, Yellow, Green	647, 568, 504 nm
Helium Neon, Diode	Red	632, 635, 650 nm
Dye	Red, Yellow, Green	632,585, 595, 504 nm
KTP	Green	532 nm
Argon	Blue, Green	488, 514 nm
XeCl Excimer	UV	308 nm
ArFl Excimer	UV	193 nm

Light Behavior



Absorption Spectrum

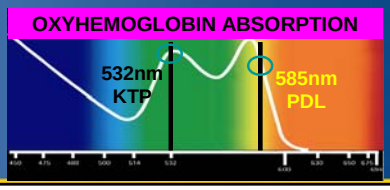
Absorption Spectrum



Pulsed KTP Laser

Pulsed Laser Angiolysis

- Selective targeting of oxyhemoglobin
  - Anderson RR et al, Science 1983
- Used first in dermatology for pigmented skin lesions, hemangiomas, port-wine stains, etc.



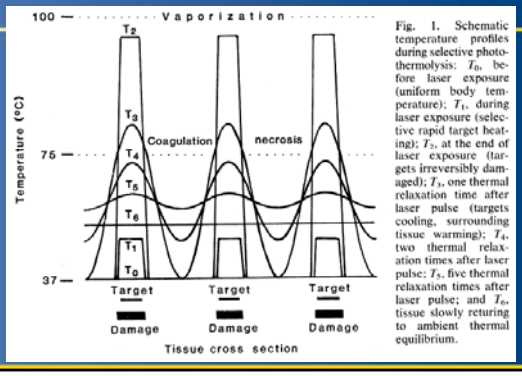
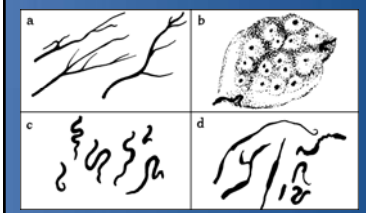
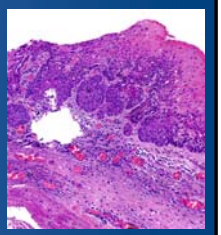


Fig. 1. Schematic temperature profiles during selective photothermolysis: T_0, before laser exposure (uniform body temperature); T_1, during laser exposure (selective rapid target heating); T_2, at the end of laser exposure (targets irreversibly damaged); T_3, one thermal relaxation time after laser pulse (targets cooling, surrounding tissue warming); T_4, two thermal relaxation times after laser pulse; T_5, five thermal relaxation times after laser pulse; and T_6, tissue slowly returing to ambient thermal equilibrium.

Tumor Angiogenesis



Jako and Kleinsasser: 1966



Folkman: 1971

Pulsed KTP Laser

Broadhurst MS, Burns JA, Akst LM, Kobler JB, Heaton JT, Anderson RR, Zeitels SM. Effects of 532nm Pulsed-KTP Laser Parameters on Vessel Ablation in the Avian Chorioallantoic Membrane: Implications for Vocal-Fold Mucosa. Laryngoscope. 2007 Feb; 117:220-225.

Vascular Malformation

Laryngeal Indications

- Epithelial Diseases
  - Papilloma – office, OR
  - Dysplasia – office, OR
  - Early invasive cancer – OR
- Vascular Malformations
  - Varix, ectasia, hemorr. polyp – OR
- Scar remodeling
  - Post-surgical, autoimmune, etc – office

Pulsed Laser Use – Technique

- Topical anesthesia of nasal cavity
- Flexible scope with light, suction, instrument port
  - Operating flexible laryngoscope
  - Transnasal laryngoscope
- Second suction, smoke evacuator for RRP
- Laser precautions for patient, personnel
  - Eyewear, masks

Technique (continued)

- Use the scope to drip 4% topical lidocaine onto the larynx
  - "Laryngeal gargle" can prolong contact
  - Multiple small aliquots
  - Be aware of toxicity
- Treat with settings that confine laser energy to target tissue
  - Pulse width ~15ms

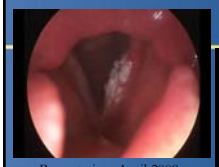
Courtesy of MGH Center for Laryngeal Surgery

Practice Management

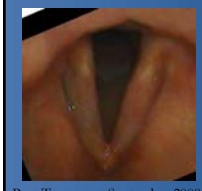
- Typically perform surgery in OR first
  - Done for papilloma, dysplasia
  - OR required for initial biopsy, as well as precise mapping
- Then transition into the office

Dysplasia – Office Treatment

Dysplasia



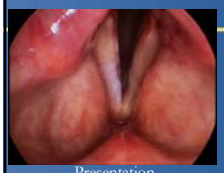
Presentation, April 2008



Post-Treatment, September 2008

Post-Treatment, September 2008

Dysplasia – Case 1

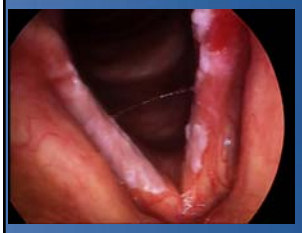


Presentation

Final Result

Result after OR / Office Procedure

Dysplasia – Case 2



Presentation

After OR

Dysplasia – Case 2

Recurrence → Office KTP

Final Result

Office KTP

Results with Pulsed KTP

- Zeitels SM, Akst LM, et al. Office Based 532nm Pulsed-KTP Laser Treatment of Glottal Papillomatosis and Dysplasia. Ann Otol Rhinol Laryngol. 2006 Sep; 115:679-685.
- 70/72 (97%) Successful Office-Based Procedures
- Dysplasia: 28 patients and 36 procedures
  - 34/36 completed
  - F/U 29/34
    - 75-100% 18/29 (62%)
    - 50-75% 7/29 (24%),
    - 25-50% 4/29 (14%).
- Papillomatosis: 20 patients and 36 procedures

Scar Remodeling

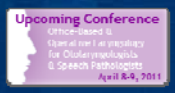
The use of the pulse dye laser in the treatment of vocal fold scar: a preliminary study. Mortensen MM, Woo P, Ivey C, Thompson C, Carroll L, Altman K. Laryngoscope, Oct 2008; 118:1884-8.

Summary of Pulsed Angiolysis

- 532nm pulsed-KTP laser is effective treatment for laryngeal dysplasia and papillomatosis in an office-based setting.
- Most patients (97%) tolerated office-based management.
- 532nm pulsed-KTP laser was more effective and easier to use than the 585nm PDL by minimizing blood extravasation onto the surface of epithelium and/or into the superficial lamina propria.
- Flexible laryngoscope trauma did not occur with the .4mm fiber; better suction
- Disease regression similar with both angiolytic lasers.

Advanced Phonsurgery: Laser Techniques

Laryngology in the OR
April 8, 2011



JOHNS HOPKINS MEDICINE

Lee M. Akst, MD Director, Johns Hopkins Voice Center

The Basics

- The principles:
  - Know when to operate
  - Good exposure
  - Save SLP
  - Aim small, miss small
- The lasers:
  - PDL
  - Pulsed KTP
  - CO_2 / Omniguide
  - Thulium

The Basics

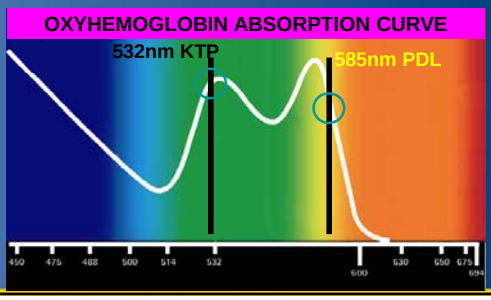
- The principles:
  - Know when to operate
  - Good exposure
  - **Save SLP**
  - Aim small, miss small
- The lasers:
  - Pulsed KTP

Pulsed Angiolysis

- Pulsed KTP Laser
- Pulsed Dye Laser
- Target oxyhemoglobin
- Pulsed energy (0.45-15 ms)
- Coagulate vessel selectively
- No thermal damage to surrounding tissue
- Anderson RR, et al. *Science* 1983

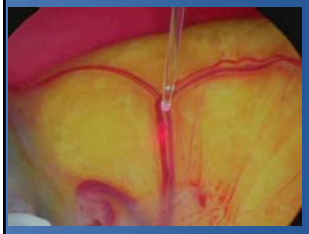
Pulsed Angiolysis

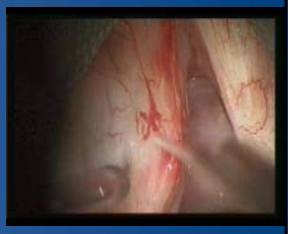
- Cutaneous lesions → Vocal Folds



Pulsed KTP Laser

- Papilloma, Dysplasia, Early Cancer
- Vascular Malformations





Chorioallantoic Membrane

Outline

- Pulsed Angiolytic Lasers
  - Vascular malformation
  - Leukoplakia
  - Recurrent respiratory papillomatosis
  - Early glottic cancer
- "Cutting" Lasers
  - Early glottic cancer
  - Cordotomy and partial arytenoidectomy

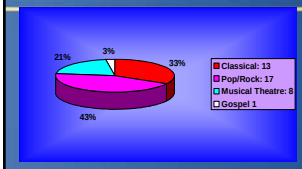
Vascular Malformations

- Decision-making
  - Is the vascular lesion related to the dysphonia?
  - (When is a small varix or ectasia an incidental finding?)
- Probably related if . . .
  - It's associated with mass lesion (eg, hemorrhagic polyp)
  - If history / exam support recurrent hemorrhage
  - If history / exam support lesion-related edema that leads to compromised vocal endurance

Vascular Malformations

- Goal is to address the vascular component as necessary
  - Pulsed dye laser
  - Pulsed KTP laser
- Other principles of phonosurgery remain the same, should further dissection be necessary

Pulsed Angiolytic Laser Treatment of Ectasias and Varices in Singers



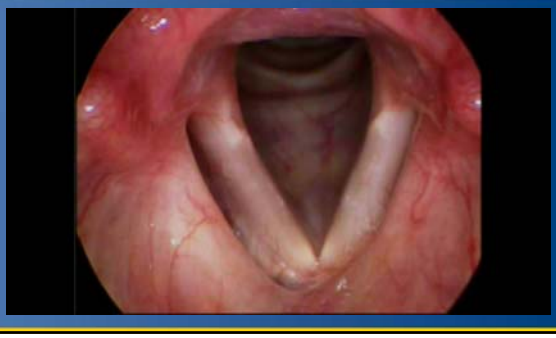
Zeitels SM, Akst LM, Burns JA, Hillman RE, Broadhurst MS, Anderson RR. Ann Otol Rhinol Laryngol 2006 Aug; 115:571-80.

- 39 pts, 40 Procedures: 54 VFs
- 33/54 PDL & 21/54 pulsed KTP
- 18/39 pts history of bleeding
- No patient with vocal deterioration
- No patient with history of re-bleeding

Vascular Malformation

Vascular Malformation

Vascular Malformation



Recurrent Respiratory Papilloma

- Diagnosis
  - Suspected visually
  - Confirmed on pathology

- Therapy – surgical debridement
  - Cold instrument, CO2 laser, soft-tissue shaver
  - Pulsed KTP laser → *preserve pliability*
  - Adjuvant : cidofovir, indole-3-carbinol, etc.
  - Multiple surgeries are expected

Recurrent Respiratory Papilloma

532 nm Pulsed Potassium-Titanyl-Phosphate Laser Treatment of Laryngeal Papillomatosis under General Anesthesia

Laryngoscope 117:1500-4, 2007

- Infusion (based on location)
- Pulsed KTP
  - Tissue necrosis
  - Addresses vasculature
- Stepwise debridement
- Identify, protect normal

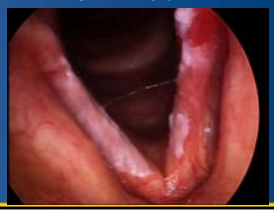
532 nm Pulsed KTP Laser Treatment of Laryngeal Papillomatosis under General Anesthesia

- 37 pts, 55 procedures
  - 35/55: close enough for short-term follow-up
  - 20/55: distant, returned when disease recurred
- >90% response 28/35 (80%)
- 75-89% response 4/35 (11%)
- 50-74% response 3/35 (9%)
- 51/55 anterior commissure disease: no webbing

Burns JA, Zeitels SM, Akst LM, Broadhurst MS, Hillman RE, Anderson RR.. Laryngoscope Aug 2007, 117:1500 –1504

Neoplasms – Leukoplakia

- Leukoplakia is the visual analog of dysplasia
  - Hyperkeratosis and parakeratosis
  - Pre-malignant lesions
    - Multi-step theory of carcinogenesis
  - Generally seen in smokers
    - Possible in non-smokers
  - Alcohol is a synergistic risk factor
- Voice varies from no change at all (superior lesion) to moderately hoarse (medial lesion)
  - Progressive dysphonia

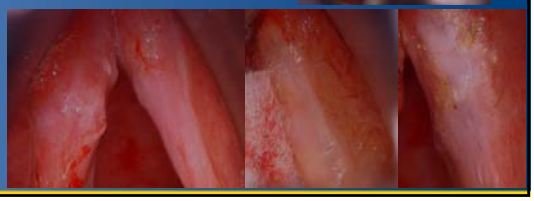


Dysplasia / Leukoplakia

- Dilemma:
  - Observe, and miss possible pre-malignant or malignant lesion?
  - OR, biopsy and risk worsening voice for what is non-invasive disease?
- Solution(?)
  - Be able to obtain diagnosis and treat the lesion, without going deeper than necessary and therefore preserving voice

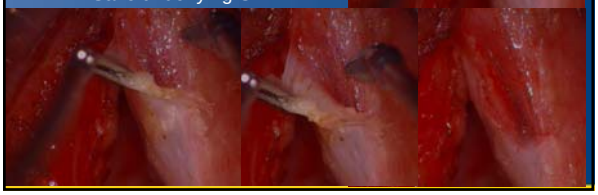
Dysplasia / Leukoplakia

- Infusion
- Pulsed KTP
  - Treats vasculature
  - Neoplasm requires angiogenesis



Dysplasia / Leukoplakia

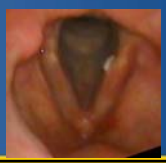
- Epithelial resection
  - Remove disease
  - Thicker disease = thicker epithelium
  - Establish diagnosis
  - Save underlying SLP



Dysplasia

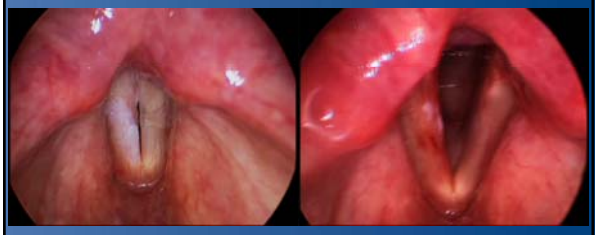
Presentation, April 2008
Pathologic Diagnosis - CIS

4 weeks after 1st OR, June 2008



4 weeks after 2nd OR, August 2008

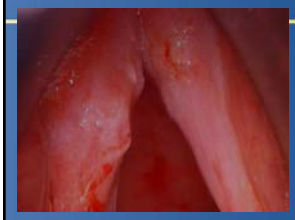
Dysplasia



Laryngeal Cancer

- Estimated 120,000 new cases/year
- Men > Women
- Smoking, EtOH risk factors
- ? Reflux as risk factor ?
- >95% squamous cell carcinoma
- ¾ patients present early because of hoarseness
  - No vocal cord fixation
  - No lymph node involvement
  - No extension outside larynx

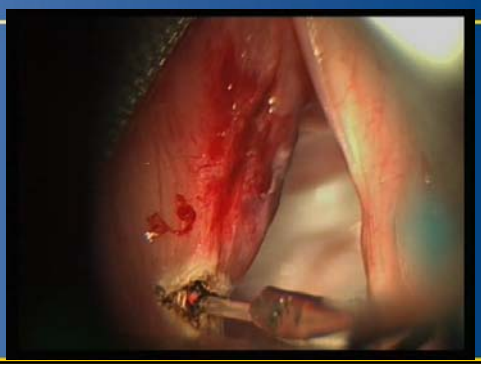
Early Laryngeal Cancer



- 39 yo with hoarseness
- Outside ENT biopsy – dysplasia
- Followed conservatively, referred when it "looked worse"

- 52 yo male with hoarseness
- Outside ENT biopsy – cancer
- Suggested radiation
- Patient desired photoangiolytic treatment

Thulium



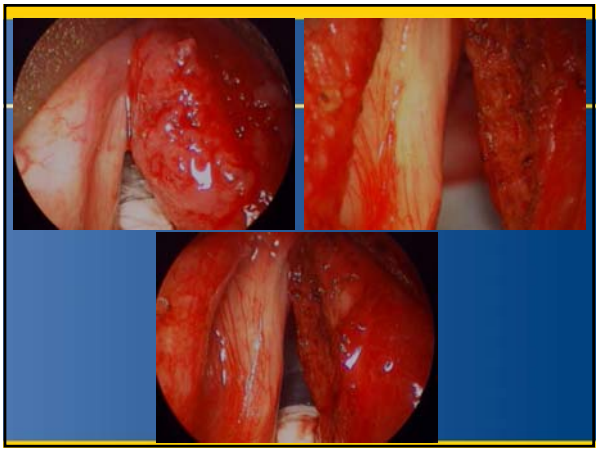
Changing Paradigm - KTP

- Routine use for dysplasia and papilloma
- Emerging use for invasive cancer

Photoangiolytic Laser Treatment of Early Glottic Cancer: A New Management Strategy

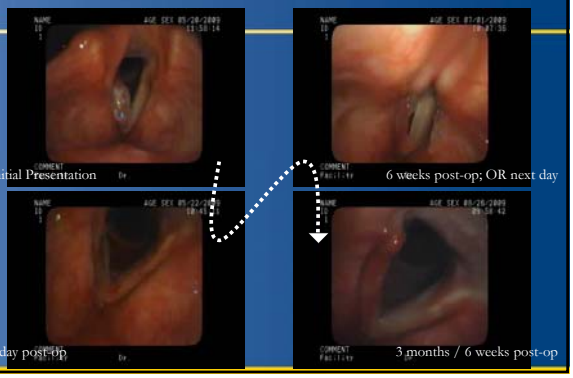
Steven M. Zeitels, MD; James A. Burns, MD; Gerardo Lopez-Guerra, MD; R. Rox Anderson, MD; Robert E. Hillman, PhD

- Staged, stepwise resection that preserves structure
- 22 patients, all with significant improvements in voice, even in patients with bilateral disease

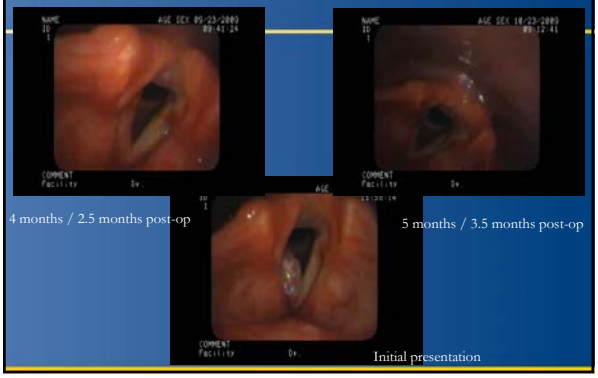


Pulsed KTP

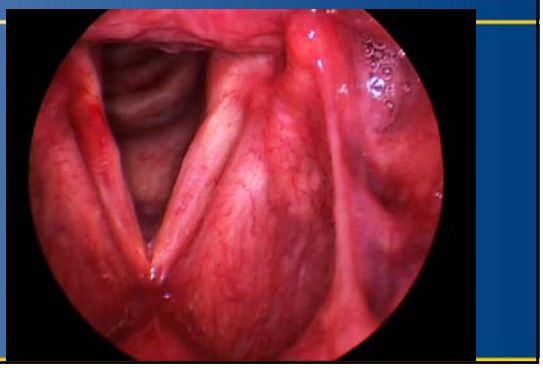
Pulsed KTP for Cancer



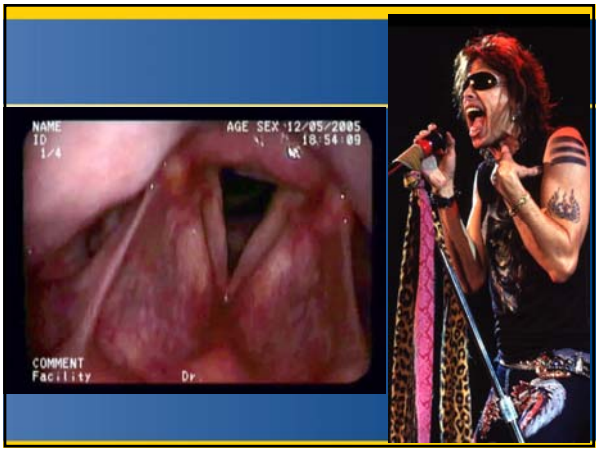
Pulsed KTP for Cancer



Recurrent Vocal Hemorrhage

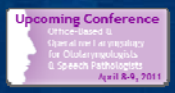


Recurrent Hemorrhage – OR



Pharyngeal pH Probe

Laryngeal Procedures in the Office
April 9, 2011



JOHNS HOPKINS MEDICINE

Lee M. Akst, MD Director, Johns Hopkins Voice Center

Disclosure

- I serve on the Clinical Advisory Board for Respiratory Technologies Company (Restech, Inc.)
- I have never been paid for this
  - No grants, no research support, no equipment loans, etc.

Background

- We've heard a lot about reflux
- I don't know about you, but I'm still confused
  - The more I learn . . .
  - The more I realize what I don't know
- Introduction
- Clinical management
  - Focus on diagnosis
  - Focus on role of pH probe – *rationale*, not technique (which is simple)

Background – Part 2

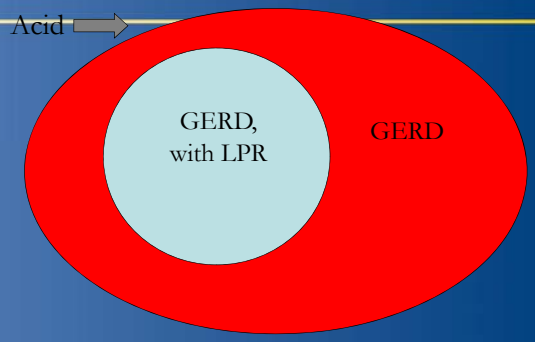
- How many of you:
  - Feel that you know reflux when you see it?
  - Feel that you treat it effectively?
    - Don't overtreat it, don't undertreat it?
  - Feel like you're bouncing patients back and forth to your GI colleagues, who disagree with the diagnosis?

GERD ≠ LPR

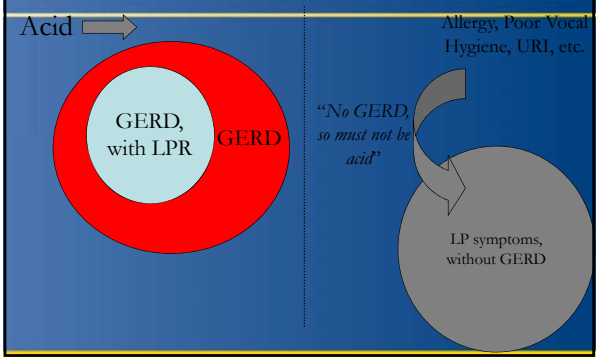



Google Image search for "Heartburn", March , 2010

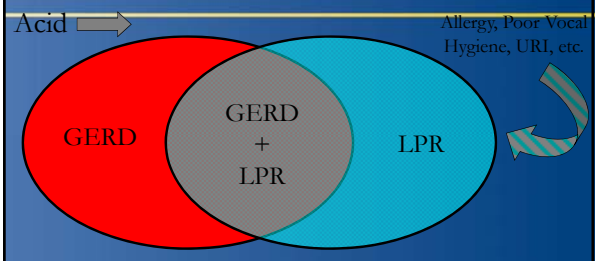
GERD vs LPR: Model 1



GERD vs LPR: Model 1, extended



GERD vs LPR: Model 2



- Acid *can* cause LP symptoms even in absence of GERD complaints
- Other etiologies *can also* cause LP symptoms

GERD vs LPR, Model 2

- Different mucosal susceptibility to injury
  - Receptor-mediated uptake of pepsin by laryngeal epithelium
  - Reactivation of tissue-bound pepsin?
- Different clearance/protective mechanisms
  - No laryngeal peristalsis
  - No laryngeal bicarbonate secretion
- Variable host response to injury at different sites
  - Molecular level – CD1d, NKT cells, etc (MA Birchall)
  - Functional level – depression, anxiety, etc (S Halum)

Introduction

- *IF* we accept that LPR can exist even without esophageal complaints,
- *THEN* our challenge is to figure out when laryngopharyngeal complaints relate to reflux and when they relate to other causes

Approaches to Diagnosing LPR

- Patient symptoms
- Physical exam
- Empiric treatment
- *pH probes*

What is the evidence?

Why are we talking about LPR?

- Increasing recognition of LPR
  - 1990-2001: annual visits for reflux up 306% (especially among ENT), PPI prescriptions increased 14-fold

    Altman et al. Laryngoscope 115:1145-53, 2005
  - Madison, WI survey of 1854 people – 26% reported both GERD and laryngeal symptoms concurrently, suspicious for LPR

    Connor et al. J Voice 21:189-202, 2007
- Increased clinical investigation, increased basic science studies, and increased discussion

Obesity Trends Among U.S. Adults between 1985 and 2008

Definitions:

- Obesity: Body Mass Index (BMI) of 30 or higher.
- Body Mass Index (BMI): A measure of an adult's weight in relation to his or her height, specifically the adult's weight in kilograms divided by the square of his or her height in meters.

Obesity Trends Among U.S. Adults between 1985 and 2008

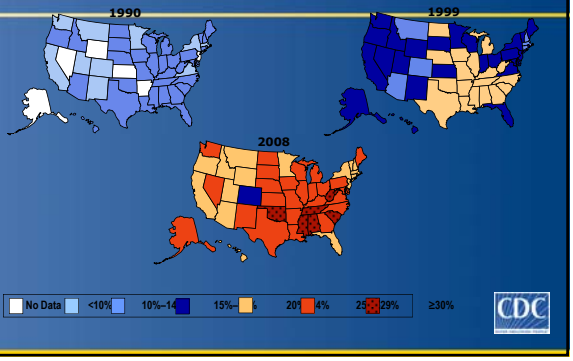
Source of the data:

- The data shown in these maps were collected through CDC's Behavioral Risk Factor Surveillance System (BRFSS). Each year, state health departments use standard procedures to collect data through a series of telephone interviews with U.S. adults.
- Prevalence estimates generated for the maps may vary slightly from those generated for the states by BRFSS (http://aps.nccd.cdc.gov/brfss) as slightly different analytic methods are used.

Obesity Trends* Among U.S. Adults

BRFSS, 1990, 1999, 2008

(*BMI ≥30, or about 30 lbs. overweight for 5'4" person)



Obesity Trends* Among U.S. Adults

BRFSS, 1985

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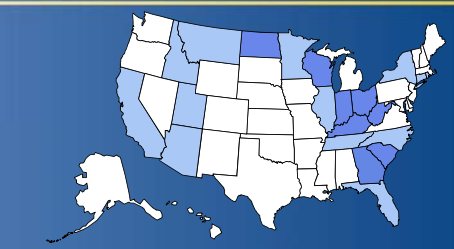

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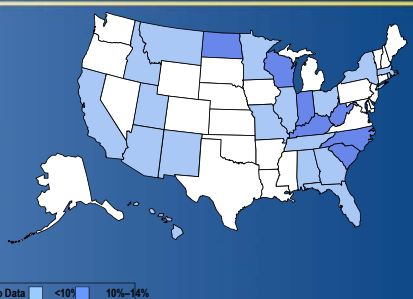

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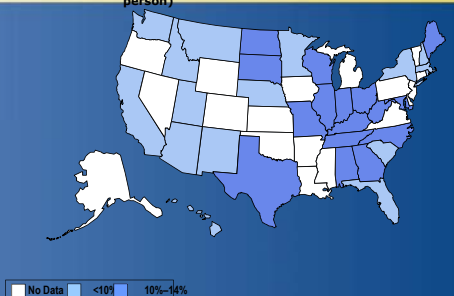
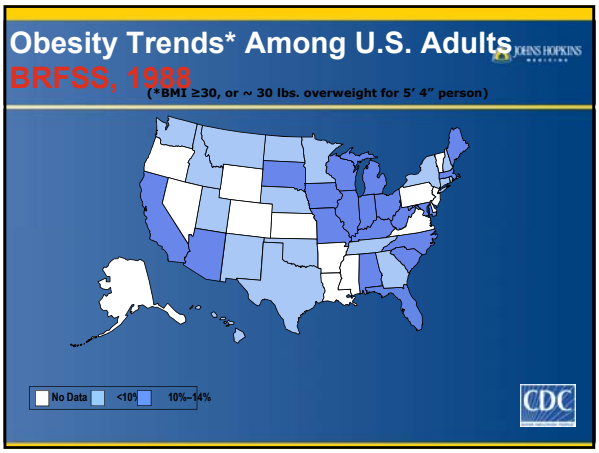
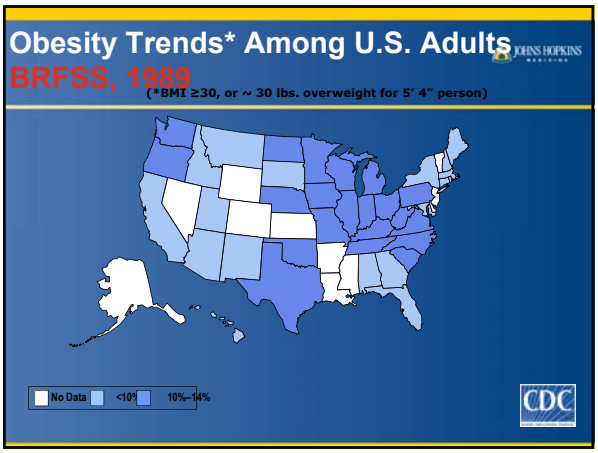



Obesity Trends* Among U.S. Adults
BRFSS, 1988
(*BMI ≥30, or ~ 30 lbs. overweight for 5' 4" person)
No Data
<10%
10%–14%
CDC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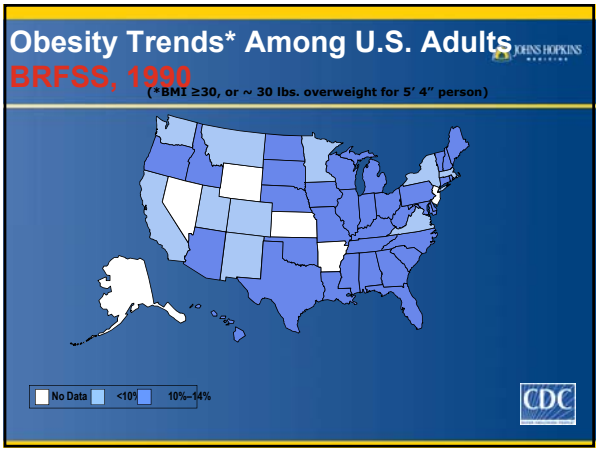
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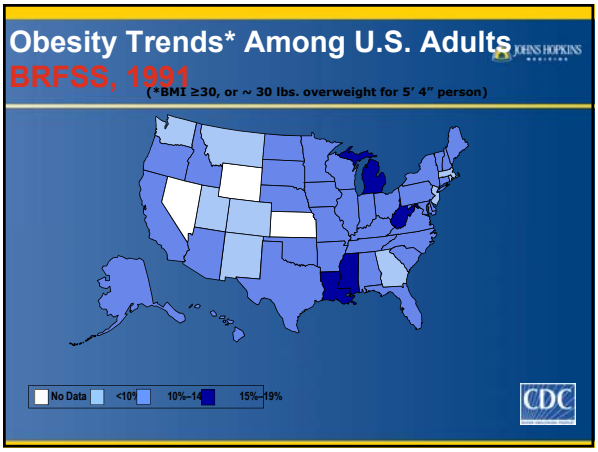
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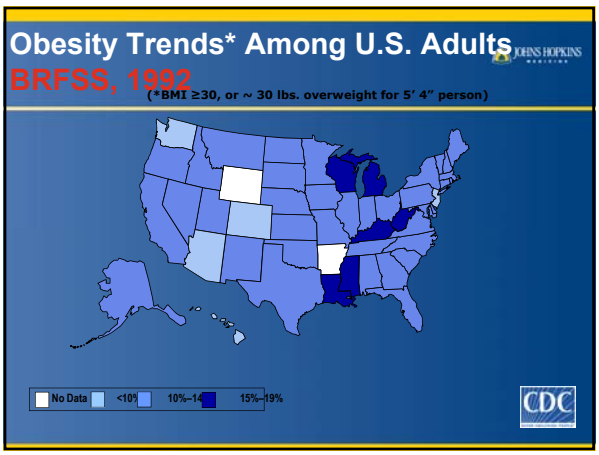
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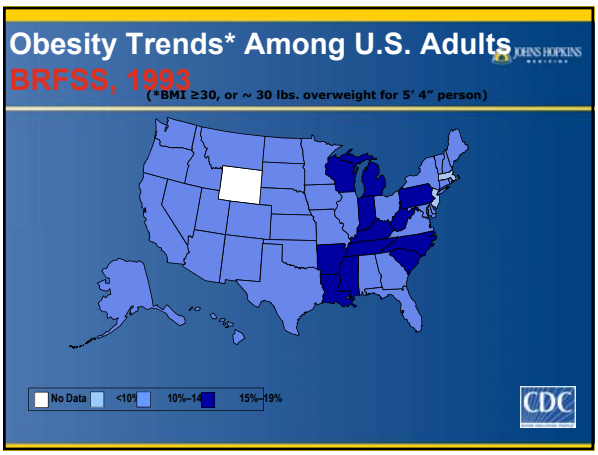
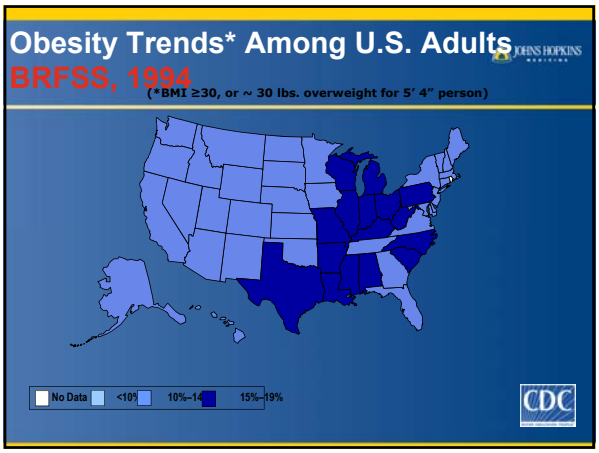
15%–19%
CDC


Obesity Trends* Among U.S. Adults
BRFSS, 1993
(*BMI ≥30, or ~ 30 lbs. overweight for 5' 4" person)
No Data
<10%
10%–14
15%–19%
CDC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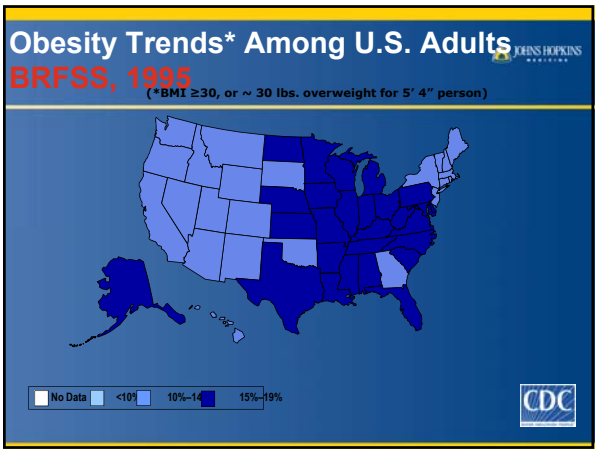
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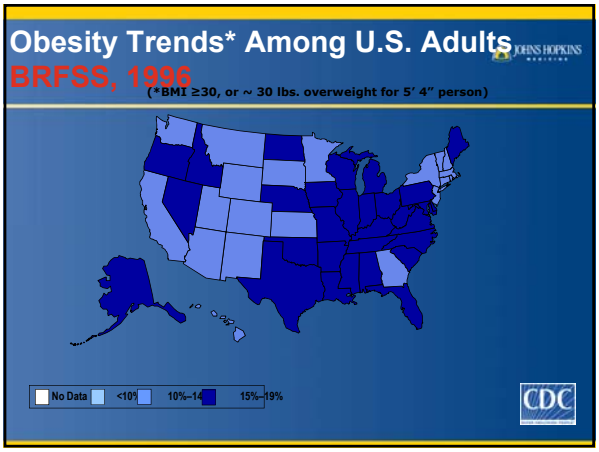
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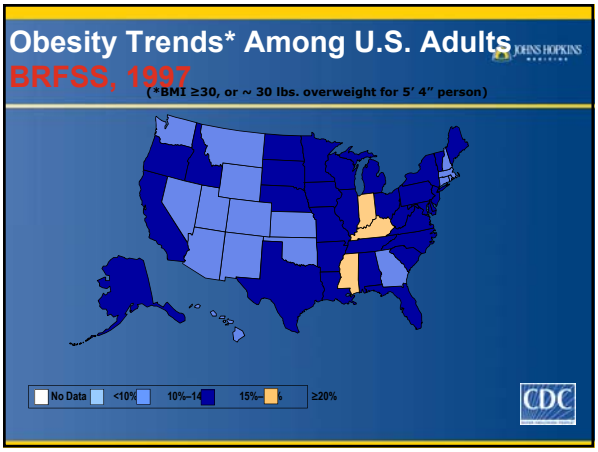
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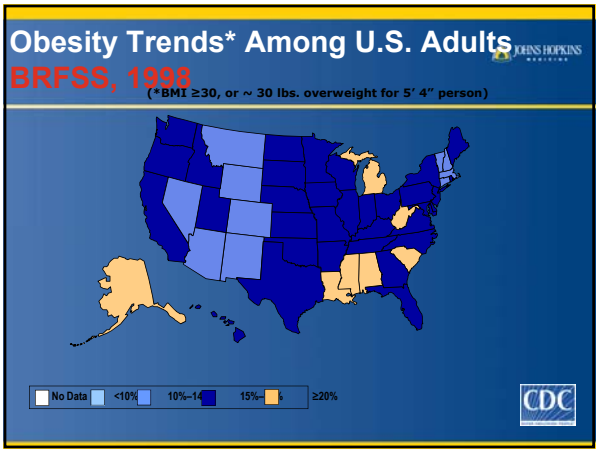
<10%
10%–14%
15%–19%
≥20%
CDC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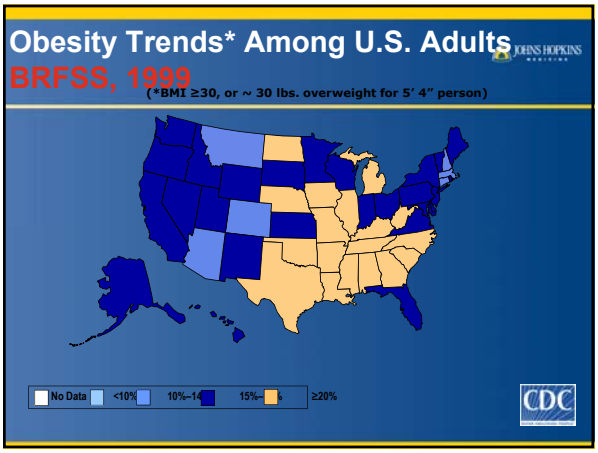
≥20%
CDC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(*BMI ≥30, or ~ 30 lbs. overweight for 5' 4" person)
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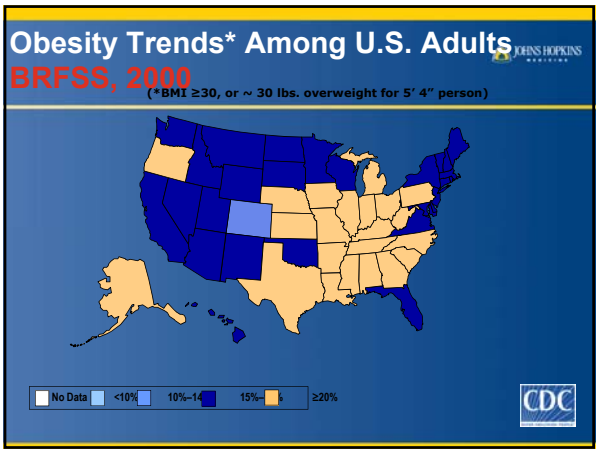
<10%
10%–14%
15%–19%
≥20%
CDC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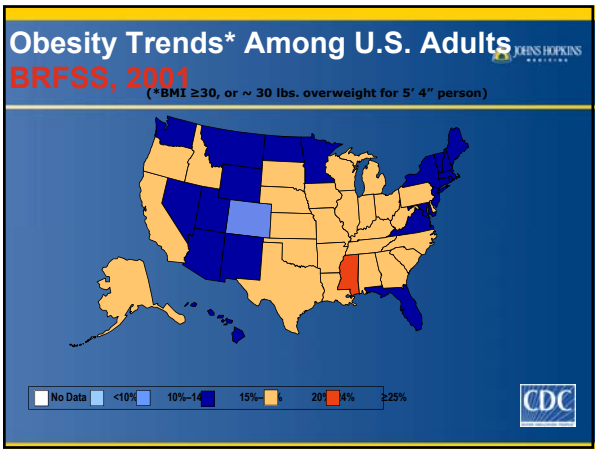
No Data
<10%
10%–14
15%–
≥20%
CDC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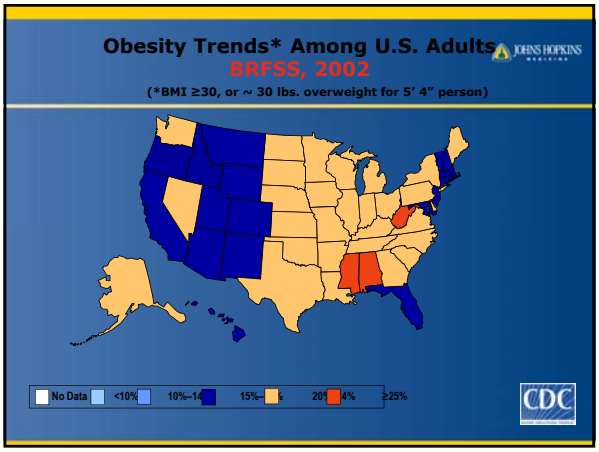
BRFSS, 2001
(*BMI ≥30, or ~ 30 lbs. overweight for 5' 4" person)
No Data
<10%
10%–14
15%–
20%
4%
≥25%
CDC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BRFSS, 2002
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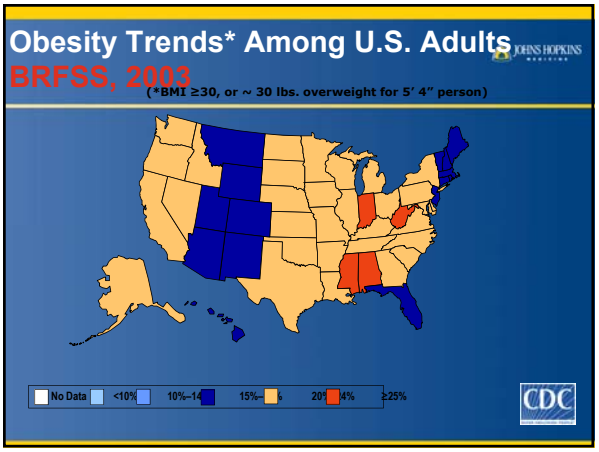
<10%
10%–14
15%–
20%
4%
≥25%
CDC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BRFSS, 2003
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<10%
10%–14
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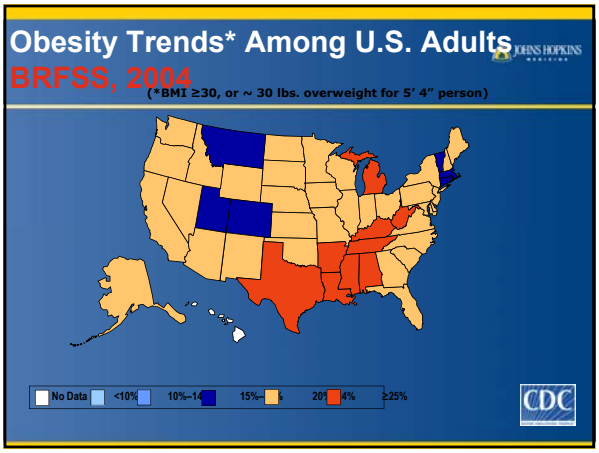
20%
4%
≥25%
CDC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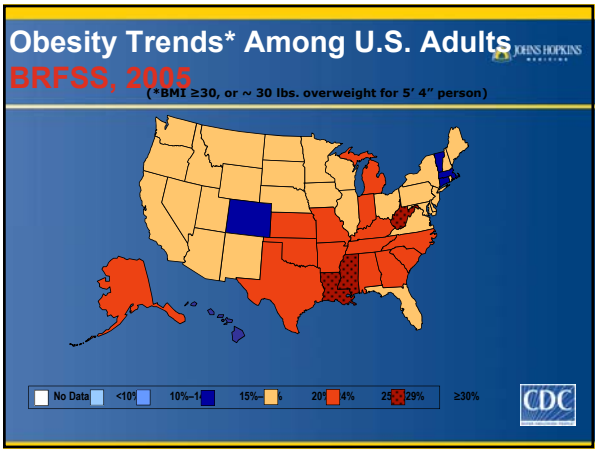
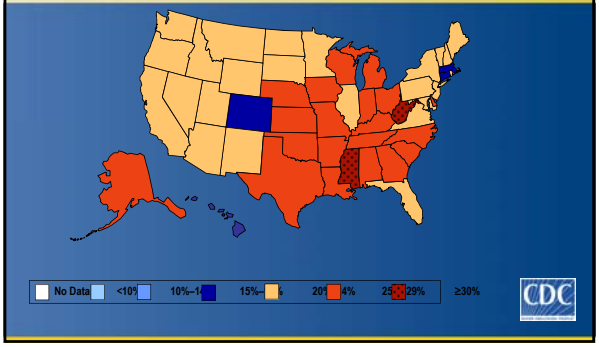
BRFSS, 2004
(*BMI ≥30, or ~ 30 lbs. overweight for 5' 4" person)
No Data
<10%
10%–14
15%–
20%
4%
≥25%
CDC


Obesity Trends* Among U.S. Adults
BRFSS, 2005
(*BMI ≥30, or ~ 30 lbs. overweight for 5' 4" person)
No Data
<10%
10%–14
15%–
20%
4%
25%–29%
≥30%
CDC

Obesity Trends* Among U.S. Adults
BRFSS, 2006
(*BMI ≥30, or ~ 30 lbs. overweight for 5' 4" person)



Obesity Trends* Among U.S. Adults
BRFSS, 2007
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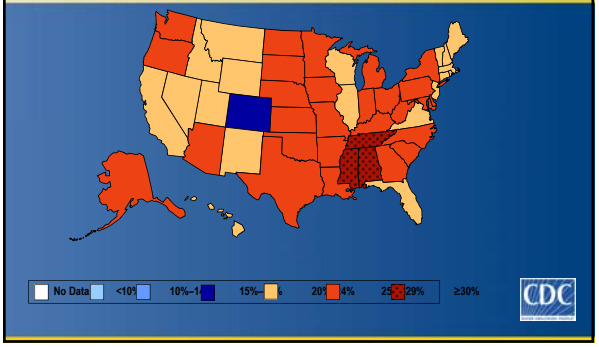
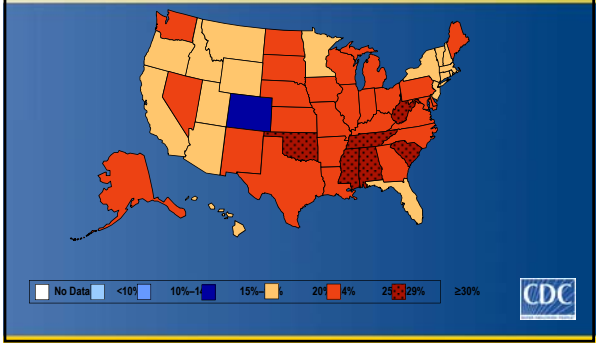


Obesity Trends* Among U.S. Adults
BRFSS, 2008
(*BMI ≥30, or ~ 30 lbs. overweight for 5' 4" person)



LPR: What we know (or think we know)

- It's prevalent, and may relate to multiple different pathologies
  - Reflux laryngitis
  - Vocal cord nodules
  - Polypoid corditis
  - Laryngeal cancer
  - Vocal process granuloma
  - Subglottic stenosis
  - Laryngospasm
  - Paradoxical vocal fold motion
  - Dysphagia
  - Zenker's diverticulum
  - Cough
  - Asthma
  - Sinusitis
  - Rhinitis
  - Otitis media

LPR Position Statement, AAO-HNSF, July 2002

Diagnosis

- Diagnosis is sometimes difficult
- Different tools:
  - Symptoms
  - Exam findings
  - Empiric therapy
  - Studies – pH probe

- There are problems with each
- Correlation may be poor

Diagnosis - Symptoms

- "The symptoms of LPR are protean; however, the most common are hoarseness, globus pharyngeus, dysphagia, cough, chronic throat clearing, and sore throat. These symptoms are often intermittent or 'chronic-intermittent.'"

Koufman et al. AAO-HNSF LPR Position Statement. Otolaryngol Head Neck Surg 127:32, 2002.

- Protean: "readily assuming different forms or characters; extremely variable

Dictionary.com

Diagnosis - Symptoms

Within the last MONTH, how did the following problems affect you?	0 = No Problem 5 = Severe Problem					
1. Hoarseness or a problem with your voice	0	1	2	3	4	5
2. Clearing your throat	0	1	2	3	4	5
3. Excess throat mucous or postnasal drip	0	1	2	3	4	5
4. Difficulty swallowing food, liquids, or pills	0	1	2	3	4	5
5. Coughing after you ate or after lying down	0	1	2	3	4	5
6. Breathing difficulties or choking episodes	0	1	2	3	4	5
7. Troublesome or annoying cough	0	1	2	3	4	5
8. Sensations of something sticking in your throat or a lump in your throat	0	1	2	3	4	5
9. Heartburn, chest pain, indigestion, or stomach acid coming up	0	1	2	3	4	5
	TOTAL					

Reflux Symptom Index. RSI>10 suggests LPR

Belafsky et al. J Voice 16:274-7, 2002

Diagnosis - Symptoms

- Problem – these symptoms are non-specific
- Other sources of laryngopharyngeal inflammation or irritation can mimic LPR
  - Environmental irritants / inhalants
  - URI
  - Allergies
  - Vocal overuse or abuse
- So, symptoms may be unreliable . . .

Diagnosis - Exam

Table 1 Reflux Findings Score

Findings	Severity Score
Subglottic edema	2 = present 1 = absent
Ventricular obliteration	2 = partial 4 = complete
Erythema	2 = arythenoids only 4 = diffuse
Vocal fold edema	1 = mild 2 = moderate 3 = severe 4 = polypoid
Diffuse laryngeal edema	1 = mild 2 = moderate 3 = severe 4 = obstructing
Posterior commissure hypertrophy	1 = mild 2 = moderate 3 = severe 4 = obstructing
Granuloma/granulation tissue	2 = present 0 = absent
Thick endolaryngeal mucus	2 = present 0 = absent
	TOTAL = (add the above)

- Reflux Finding Score
  - RFS ≥ 11 suggests LPR
  - Validated on pH probe + LPR patients
  - Intra-observer reliability
  - Inter-observer reliability

Belafsky et al. Laryngoscope 111:1313-7, 2001

Diagnosis - Exam

- Laryngeal findings attributed to LPR can be found in 86% of normal controls

Hicks et al. J Voice 16:564-579, 2002

- Flexible scopes may be more sensitive, but less specific than rigid scopes in noting findings such as arytenoid irritation, ventricular obliteration, pseudosulcus, etc. – even in asymptomatic volunteers

Milstein et al. Laryngoscope 115:2256-61, 2005

- So, exam may be unreliable as well . . .

Diagnosis – Signs and Symptoms

- Diagnosis on clinical grounds is okay, but not great
- "I know it when I see it"

Justice Potter Stewart, *Jacobellis v. Ohio*, 1964

- Confirmation
  - Empiric response to treatment
  - pH probe studies
- Not surprisingly, controversy exists here too

Treatment

- Response to empiric PPI should confirm diagnosis
- Multiple studies show statistical improvement in symptoms, signs of LPR

Karkos, Wilson. Laryngoscope 116:144-8, 2006

- BID therapy > qD therapy, 4 months > 2 months

Park et al. Laryngoscope 115:1230-8, 2005

- Jitter, shimmer, and NHR improved over baseline by 1-2 months with treatment, and improvement is maintained at 3-4 months

Jin et al. Laryngoscope 118: 938-41, 2008

Treatment

- *However*, many randomized controlled trials with placebo controls don't show a difference

  Karkos, Wilson. Laryngoscope 116:144-8, 2006

- Most symptoms may improve over time, even in placebo group

  Noordzij et al. Laryngoscope 112:2192-5, 2002

- Acoustic abnormalities did not change significantly with PPI therapy

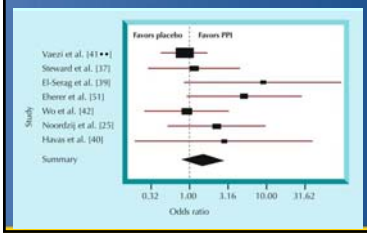
  Hamdan et al. Acta Otolaryngol 121:868-72, 2001

Treatment

Proton Pump Inhibitor Therapy for Suspected GERD-Related Chronic Laryngitis: A Meta-Analysis of Randomized Controlled Trials

Mohammed A. Qadeer, M.D.,[1] Christopher O. Phillips, M.D., M.P.H.,[2,3] A. Rocio Lopez, M.S., M.P.H.,[3] David L. Steward, M.D.,[4] J. Pieter Noordzij, M.D.,[5] John M. Wo, M.D.,[6] Maria Suurna, M.D.,[4] Thomas Havas, M.D.,[7] Colin W. Howden, M.D.,[8] and Michael F. Vaezi, M.D., Ph.D., M.Sepi.[9]

Am J Gastroent 2006;101:2646–2654



- The good news: empiric treatment *might* be more effective clinically than placebo

Treatment

- The bad news: it's fairly poor as confirmatory of reflux as etiology of patient complaints
- Somewhat worse: it doesn't help us to manage the non-responders
- Worse yet: empiric treatment is not without side effects

Treatment – Side Effects

- Limits calcium absorption
  - Ostepenia
  - Hip fracture
- Increases pneumonia risk
  - (Real risk may be reflux itself)
- Decreases plavix efficacy

Treatment – Side Effects

Long-term Proton Pump Inhibitor Therapy and Risk of Hip Fracture

Yu-Xiao Yang, MD, MSCE
James D. Lewis, MD, MSCE
Solomon Epstein, MD
David C. Metz, MD

Context Proton pump inhibitors (PPIs) may interfere with calcium absorption through induction of hypochlorhydria but they also may reduce bone resorption through inhibition of osteoclastic vacuolar proton pumps.

Objective To determine the association between PPI therapy and risk of hip fracture.

Design, Setting, and Patients A nested case-control study was conducted using the General Practice Research Database (1987-2003), which contains information on patients in the United Kingdom. The study cohort consisted of users of PPI therapy and nonusers of acid suppression drugs who were older than 50 years. Cases included all patients with an incident hip fracture. Controls were selected using incidence density sampling, matched for sex, index date, year of birth, and both calendar period and duration of up-to-standard follow-up before the index date. For comparison purposes, a similar nested case-control analysis for histamine 2 receptor antagonists was performed.

Main Outcome Measure The risk of hip fractures associated with PPI use.

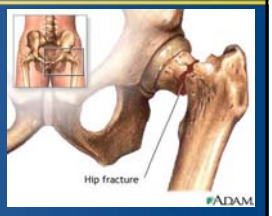
Results There were 13 556 hip fracture cases and 135 386 controls. The adjusted odds ratio (AOR) for hip fracture associated with more than 1 year of PPI therapy was 1.44 (95% confidence interval [CI], 1.30-1.59). The risk of hip fracture was significantly increased among patients prescribed long-term high-dose PPIs (AOR, 2.65; 95% CI, 1.80-3.90; $P<.001$). The strength of the association increased with increasing duration of PPI therapy (AOR for 1 year, 1.22 [95% CI, 1.15-1.30]; 2 years, 1.41 [95% CI, 1.28-1.56]; 3 years, 1.54 [95% CI, 1.37-1.73]; and 4 years, 1.59 [95% CI, 1.39-1.80]; $P<.001$ for all comparisons).

Conclusion Long-term PPI therapy, particularly at high doses, is associated with an increased risk of hip fracture.

JAMA. 2006;296:2947-2953 www.jama.com

Treatment – Side Effects

- Odds ratio of hip fracture:
  - 1 year of PPI: 1.22
  - 2 years of PPI: 1.41
  - 3 years of PPI: 1.54
  - 4 years of PPI: 1.59



nlm.nih.gov

- "Long term high-dose PPI": 2.65

Treatment – Side Effects

Proton-Pump Inhibitor Therapy Induces Acid-Related Symptoms in Healthy Volunteers After Withdrawal of Therapy

CHRISTINA REIMER,* BO SØNDERGAARD,* LINDA HILSTED,‡ and PETER BYTZER*

*Department of Medical Gastroenterology, Køge University Hospital, Copenhagen University; and the ‡Department of Clinical Biochemistry, Rigshospitalet, Copenhagen, Denmark

Gastroenterology 2009;137:80–87

- PPI may *cause* reflux in normal volunteers → Rebound Acid Hypersecretion (RAHS)
- 120 healthy volunteers: Placebo vs Nexium for 8 weeks
- Then 4 weeks of placebo, with reporting of symptoms
- 44% Nexium group vs 15% Placebo with ≥ 1 symptom
- Statistically significant for each timepoint, week 9 - 12

Treatment – Conclusions

AGA INSTITUTE

American Gastroenterological Association Medical Position Statement on the Management of Gastroesophageal Reflux Disease

6. What Is the Best Initial Management for Patients With Suspected Extraesophageal Reflux Syndromes (Asthma, Laryngitis, Cough)? What Are the Unique Management Considerations With Each? What Is the Appropriate Dose and Course of Antisecretory Therapy in Each?

Grade B: recommended with fair evidence that it improves important outcomes

1. Acute or maintenance therapy with once- or twice-daily PPIs (or H_2RAs) for patients with a suspected extra-esophageal GERD syndrome (laryngitis, asthma) with a concomitant esophageal GERD syndrome.

Grade D: recommend against, fair evidence that it is ineffective or harms outweigh benefits

1. Once- or twice-daily PPIs (or H_2RAs) for acute treatment of patients with potential extraesophageal GERD syndromes (laryngitis, asthma) in the absence of a concomitant esophageal GERD syndrome.

Grade Insuff: no recommendation, insufficient evidence to recommend for or against

1. Once- or twice-daily PPIs for patients with suspected reflux cough syndrome.

- Grade B: Treat EER *if* accompanied by GERD
- Grade D: "Recommend against, fair evidence that it is ineffective or harms outweigh benefits" for potential EER in absence of GERD
- Return to paradigm of models . . .

Treatment – Notes

- Why do they say this?
- Recommendations have GI perspective
  - No Otolaryngologists on the panel
  - "Suspected Extra-esophageal GERD syndromes"

Chronic cough, laryngitis, and asthma have an established association with GERD on the basis of population-based studies. However, cough, laryngitis, and asthma have a multitude of potential etiologies other than GERD, making them nonspecific for GERD. Furthermore, the causal relationship of GERD with these nonspecific syndromes in the absence of a concomitant esophageal GERD syndrome remains controversial and unproven. The only randomized controlled trials showing a treatment effect for GERD therapies in these syndromes were in patients with esophageal GERD syndromes in addition to either laryngitis or asthma. Hence, existing evidence supports the following: (1) the association between these syndromes and GERD, (2) the rarity of extraesophageal GERD syndromes without concomitant esophageal symptoms or findings, (3) that suspected extraesophageal GERD syndromes are usually multifactorial, and (4) that data substantiating benefit from the treatment of reflux for the extraesophageal syndromes are very weak. Furthermore, clinical predictors implicating GERD in the extraesophageal syndromes have proven elusive, and the premature adoption of flawed diagnostic criteria has likely resulted in the overdiagnosis of extra esophageal GERD syndromes.

So, where does this leave us?

- Dilemma: knowledge vs practice management
- Reality: we need to do something

In summary, patients with suspected extraesophageal GERD syndromes may have GERD as a contributing etiology but rarely as the sole cause. However, the increasing incrimination of GERD as an etiologic factor along with the lack of accurate confirmatory diagnostic tests has resulted in widespread overdiagnosis and overtreatment of these conditions. Nonetheless, empirical therapy with twice-daily PPIs for 2 months remains a pragmatic clinical strategy for subsets of these patients if they have a concomitant esophageal GERD syndrome. Failing such a trial, etiologies other than GERD should be explored.

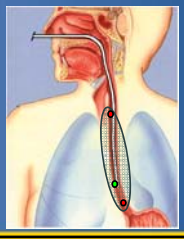
(Who feels good about this?)

So how do we do better?

How do we add science to the art of reflux care?

pH Probes

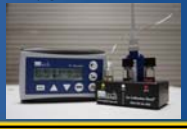
- Helps to establish diagnosis
- Can assess response to therapy
  - i.e., tell us what to do with the non-responders

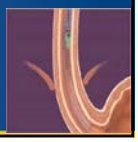


Dual-chamber Esophageal

Wireless

Pharyngeal





pH Probe

- "Gold standard" (AAO-HNSF LPR Position Statement, 2002)
- Difficulties with traditional pH probes
  - Can you use an esophageal probe as proxy for what happens in the pharynx?
  - If you re-position a proximal probe from beneath UES to above UES, does it provide valid measurements?
  - What constitutes a positive test?

Meta-analyses: pH Results and Clinical Diagnoses

- Significant difference in: Number of pharyngeal reflux (PR) events and mean percentage of acid exposure times
- PR events occur in 51.2% ± 4.3% of LPR patients

  Merati et al. Ann Otol Rhonol Laryngol 114:177-82, 2005
- Only 38.3% (CI 25.4 – 52.1%) of LPR patients had PR event
- 22.9% of controls had PR event – not statistically different

  Joniau et al. Otolaryngol Head Neck Surg 136:686-92, 2007
- This review is "biased"

  Belafsky. Otolaryngol Head Neck Surg 137:984, 2007
- "There are 3 kinds of lies: lies, damned lies, and statistics"

  Benjamin Disraeli, popularized by Mark Twain

Triple Sensor Data

- 41 patients with suspected LPR
  - 40/41 abnormal with triple probe; only 29/41 abnormal with dual esophageal probes
  - Significant false negative rate if use esophageal sensor as proxy

  Harrell et al. Laryngoscope 2005; 115:89-92.
- 33 patients with symptoms of LPR
  - 4/17 Pharyngeal + patients negative in the esophagus
  - 6/19 Prox Esoph + patients negative in the pharynx
  - Significant false negative rate if use esophageal sensor as a proxy
  - Significant false positive if use traditional sensor in hypopharynx without esophageal confirmation

  Muderris et al. Arch Oth-HNS 2009; 135:163-7.

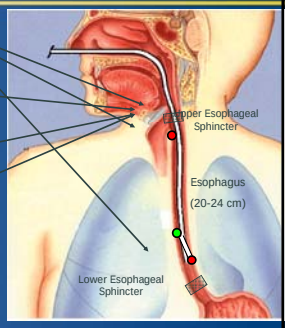
Problems: Esophageal Sensor in Pharynx

» Esophageal Sensors too low for detection of LPRD

» If the 2nd channel is placed higher it dries out due to air contact

» Sensor can be fouled by mucus

» Mucosal contact can mask reflux events



Traditional pH Probes

PRACTICE GUIDELINES

ACG Practice Guidelines: Esophageal Reflux Testing

Ikuo Hirano, M.D.,[1] Joel E. Richter, M.D.,[2] and the Practice Parameters Committee of the American College of Gastroenterology[4]

Am J Gastro 2007;102:668-685

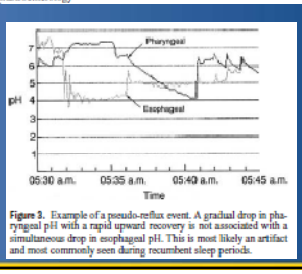


Figure 3. Example of a pseudo-reflux event. A gradual drop in pharyngeal pH with a rapid upward recovery is not associated with a simultaneous drop in esophageal pH. This is most likely an artifact and most commonly seen during recumbent sleep periods.

"Pseudo-reflux" with drying artifact

However, probe positioning is highly operator-dependent and variable (direct visualization by laryngoscopy *versus* measurement by manometry), artifacts are common, therefore, the computer interpretations need to be reviewed manually (70), the range of normals is poorly defined (none to 4 pH drops <4) (124–126), and 10–30% of healthy volunteers meet published criteria for abnormal pharyngeal reflux, suggesting some reflux into the hypopharnx may be a normal phenomenon (127). Even applying less restrictive pH criteria (*i.e.*, pH drop of 1.0 or 1.5 units rather than 2.0 units) does not help discriminate healthy volunteers and patients with suspected reflux-related ENT complaints (128). Finally, and most clinically relevant, several studies found that positive results of pharyngeal testing do not predict a more favorable response to antireflux therapy (124, 129). For example, Ulualp *et al.* (129) reported that the degree of symptom improvement in 19 of 27 patients exhibiting pharyngeal reflux episodes was similar to the remaining eight patients not having pharyngeal reflux.

In light of these limitations and controversies, the available evidence does not support the routine use of proximal pH monitoring in clinical practice.

Traditional pH Probes

- "Exclusion of pH artifacts is essential for HP monitoring"
  - Single-catheter, 3-sensor probe; suspected LPR pts, off therapy
  - Positive = at pH 4: 3 HP episodes, at least 1% proximal esophagus, and at least 4.2% distal esophagus
  - 2225 HP pH drops: 48% too short (<5s), 17% during meals, 16% liquid swallows outside meals; 16% isolated HP drops; 12% pH out of range; 5% pH drift
  - Yield of HP sensor as predictor of positive test went from 92% → 47% after controlling for these 6 artifacts

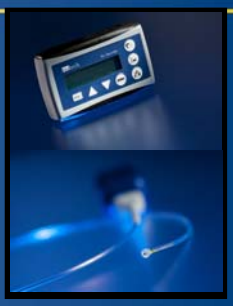
Harrell et al. Laryngoscope 2007; 117:470-4.

- "Esophageal pH testing using pH catheters and wireless pH monitors, once considered the gold standard for diagnosing GERD, have NOT shown adequate sensitivity and specificity for this group of (LPR) patients"

Sun et al. Laryngoscope 2009; 119:1639-43.

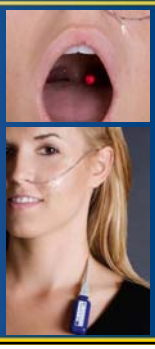
Pharyngeal pH Probe

- Respiratory Technology Company (Restech)
- Nasopharyngeal catheter
- HP probe only – no esophageal measurements



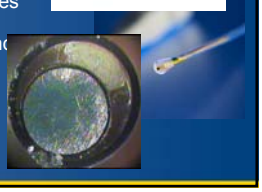
Pharyngeal pH Probe

- Positioned 5-10 mm beneath uvula
- LED aids positioning (no manometry)
- Transmitter secured to collar
- Receiver / recorder worn on belt



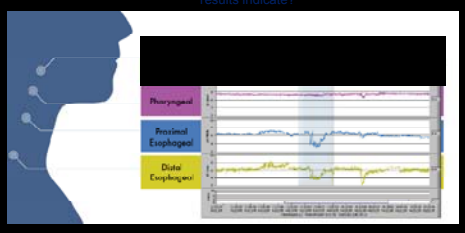
Pharyngeal Probe Sensor

- 3.2 mm teardop tip with 1 mm antimony sensor
- 2 Hz sampling rate (vs 0.2 Hz)
- Aerosolized droplets
  - Moisture in exhaled air creates fluid layer which bridges between antimony sensor and reference electrode
- Hydration monitor
- Downward aim limits masking



Pharyngeal pH Probe

Triple probe conventional study –
checking for Extraesophageal Reflux – what do the results indicate?



Pharyngeal Probe Tracks Esophageal Measurements

Preliminary Comparison of an Oropharyngeal Aerosolized pH Probe and a Standard Dual pH Probe for Diagnosis of Laryngopharyngeal Reflux

Justin S. Golub, BA; Michael M. Johns III, MD; John M. DelGaudio, MD; Adam M. Klein, MD

- Poster with small N
- Subsequent paper with larger sample
- Pharyngeal probe sensitive and specific
- Episodes track over time

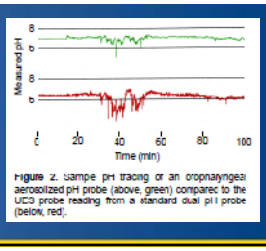


Figure 2. Sample pH tracing of an oropharyngeal aerosolized pH probe (above, green) compared to the UCSF probe reading from a standard dual pH probe (below, red).

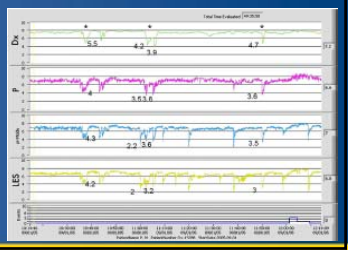
Pharyngeal Probe Tracks Esophageal Measurements

Oropharyngeal pH Monitoring for the Detection of Liquid and Aerosolized Supraesophageal Gastric Reflux

*Gregory J. Wiener, †Ross Tsukashima, ‡Colleen Kelly, †Erich Wolf, †Molly Schmeltzer, †Charles Bankert, †Lauren Fisk, and †Michael Vaezi, *Chula Vista, California; †Provo, California; and ‡San Diego, California and §Nashville, Tennessee

J Voice. 2009; 23:498-504.

- 15 patients, simultaneous measured with 2 probes
- All Dx-pH events were associated with distal esophageal drops which progressed antegrade
- Median pH: distal 3.1, proximal 5.2, pharynx 5.6



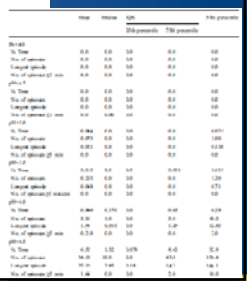
RYAN Score

ORIGINAL ARTICLE

A New Technique for Measurement of Pharyngeal pH: Normal Values and Discriminating pH Threshold

S. Ayazi · J. C. Lipham · J. A. Hagen · A. E. Tang · J. Zecheim · J. M. Leon · A. Onuchi · E. Abate · F. Banki · S. R. DeMeester · T. R. DeMeester

- Thomas Ryan DeMeester, USC
- 55 normal subjects
- 95th percentile, with thresholds of 5.5 upright, 5.0 supine
- "Overcomes artifacts"



RYAN Score

24-hour Pharyngeal pH Measurement	Upright	Supine	
Based on 95th percentile values in 55 normal subjects.	pH < 5.5	pH < 5.0 (suggestive)	pH < 4.5 (confirmatory)
% Time Below Threshold	<0.13	<5.15	<1.54
Number of Episodes	<1.20	<4.00	<1.20
Longest Episode (min)	<0.71	<18.97	<7.11
Ryan Composite Score	<9.41	<6.79	<4.88

- Analysis can exclude meals
- Can adjust thresholds for analysis
- Can measure by other criteria (ie, 10% drop from moving baseline, etc)

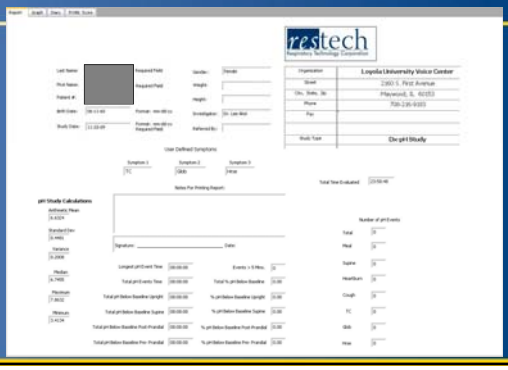
Pharyngeal pH Probe – Summary

- It measures what it is supposed to
- It is well-tolerated
- It helps with diagnosis and management of laryngopharyngeal complaints which might or might not relate reflux
- No esophageal information
- Doesn't factor in non-acid reflux
- May be used in complimentary fashion with esophageal dual pH impedance

Sample Patient

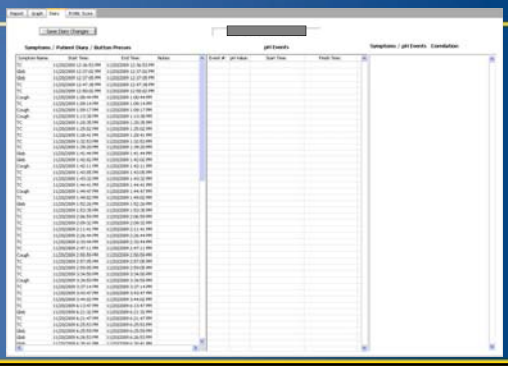
- 49 yo female with dysphagia to solids, progressive for 3 years; now limited to liquids, with -30 lb weight loss over 3 months
- Episodic heartburn, about 1-2x per month
- + globus and throat clearing – "but it doesn't bother me"
- CP hypertonicity and HP redundancy on MBS, but no Zenker's diverticulum
- Unwilling to take PPI or H2-antagonist without proof of reflux

Patient Report



Patient Graph

Patient Diary



Patient RYAN Score

Patient RYAN Score

	Upright pH < 5.5	
	Patient's Value	Normal Value
% Time Below Baseline	0.89	<0.13
Number of Episodes	17	<1.20
Longest Episode	2.8	<0.71
RYAN Score	52.99	**<9.41**

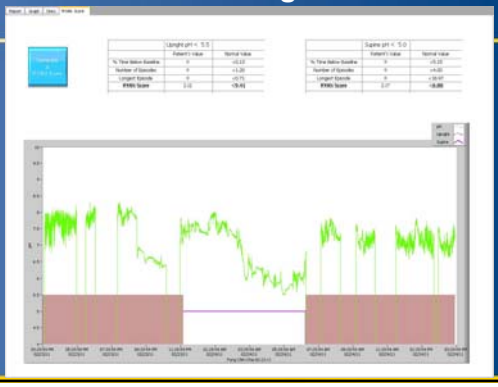
	Supine pH < 5.0	
	Patient's Value	Normal Value
% Time Below Baseline	2.44	<5.15
Number of Episodes	4	<4.00
Longest Episode	11.79	<18.97
RYAN Score	6.4	**<6.80**

- Upright: RYAN score 52.99 (normal <9.41)
  - Mild-moderate reflux
- Supine: RYAN score 6.4 (normal <6.8)
  - No excessive reflux
- AM PPI and PM H2 antagonist peri-operatively
- Switch to BID H2 antagonist for maintenance therapy

Pt 2 – Chronic Cough

- 61 yo Female, c/o chronic cough following lung surgery to remove a T1 carcinoid tumor
- Cough improved but persistent on steroid inhalers per pulmonary
- Also c/o occasional globus pharyngeus, throat clearing, and dry throat; no heartburn or acid brash
- Reflux? Or laryngeal inflammation caused by the cough itself?
- Concerned about PPI impact on calcium, preferred pH probe to empiric challenge

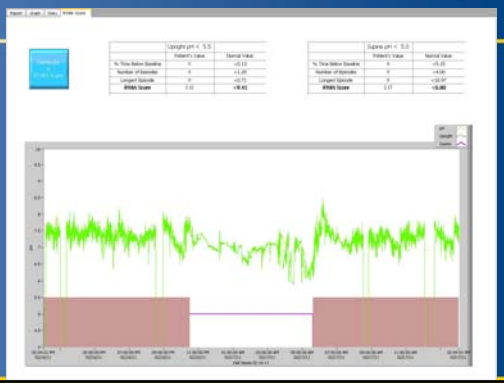
Pt 2 – Chronic Cough



Pt 3 – Refractory vocal process granuloma

- 50 yo Male with c/o throat pain, cough, PND, etc during URI
- URI resolves; throat pain persists
- Vocal process granuloma identified; treated with PPI
- Lesion persists and is removed
- Post-op exam, lesion is back → referred to me
- Reflux care maximized, scheduled for pharyngeal pH probe to ensure adequacy of PPI regimen

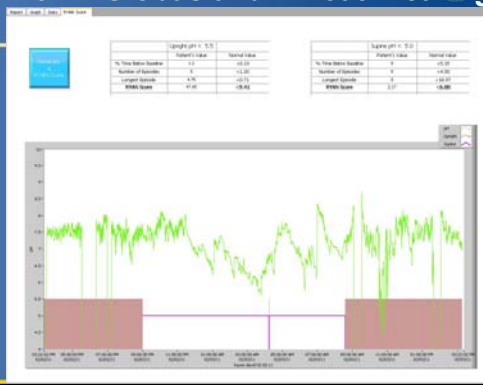
Pt 3 – Granuloma



Pt 4 – Globus and Throat Clearing

- 55 yo male with several year history of persistent globus pharyngeus and throat clearing, started at time of very increased job stress
- Refractory to PPI, upper esophageal dilation, neurontin, and klonopin
- Had tried Prevacid 30 mg daily without response
- Now on Prevacid 15 mg PO BID – with breakfast and 1 hour before dinner
- No heartburn or acid brash on PPI; severe heartburn and acid brash off of PPI
- Reflux? Globus hystericus?

Pt 4 – Globus and Throat Clearing



Pt 5 – More globus and throat clearing

- 43 yo female with globus pharyngeus, throat clearing, dry/scratchy throat, occasional non-productive cough x3 years
- Bravo capsule pH probe – "mildly high acid" off of therapy
- MBS – small hiatal hernia
- Nexium 40 mg, 30 minutes before breakfast → no heartburn, but no change in her pharyngeal symptoms

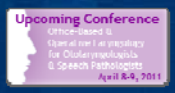
Pt 5 – Globus and throat clearing

Conclusion

- LPR can be difficult to diagnose
- Difficult diagnosis makes it difficult to manage
  - When empiric therapy works, everyone is happy
  - But what happens when it doesn't?
  - And what about the risks?
- pH probes can help with both diagnosis and management
  - For LPR, I prefer a pharyngeal probe

General Principles of Microlaryngeal Surgery

Laryngology in the OR
April 8, 2011



JOHNS HOPKINS MEDICINE

Lee M. Akst, MD Director, Johns Hopkins Voice Center

Principles

1. Know when to operate
2. Use the right tools
3. Physiology informs technique

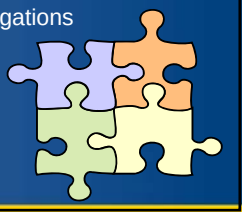
These principles are seen in the evolution of the field → get the best possible view, operate to preserve and restore function

JOHNS HOPKINS MEDICINE

Know When to Operate

Pre-operative Decision Making

- Put the puzzle pieces together
  - Joint decision between me and patient
  - Patient complaints
  - Patient voice needs / obligations
  - Exam findings
  - Non-surgical therapies



Pre-operative Decision Making

- Risks
- Benefits
- Alternatives

Risks vs. Benefits

- Dental injury
- Tongue numbness
- Failure to get desired voice outcome
- Potential to worsen voice

vs.

- Potential to improve voice
- (Also: establish pathologic diagnosis, treat malignancy, etc)

Alternatives

- Nonsurgical management
- Voice therapy
- Vocal hygiene / technique
- Reflux management (if contributing)

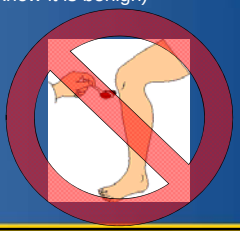
- *Partner with Speech Language Pathology*

Indications for Surgery

- Voice complaints which:
  - Are correlated to the lesion noted on exam
  - Prevent the patient from meeting occupational / social / personal voice needs
  - Persist despite adequate non-surgical therapies as appropriate

Indications for Surgery

- Just seeing a lesion does *not* mean that it needs to come out (if you have a good exam and know it is benign)



Surgical Tools

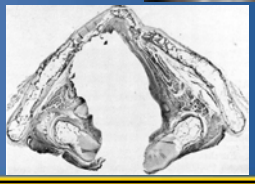
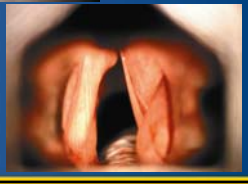
Surgical Tools

- Universal modular glottiscope
- Gallows suspension arm
- Infusion needle
- (KTP laser – we'll get there later….)

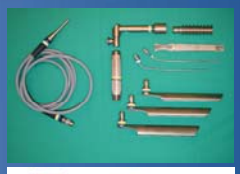


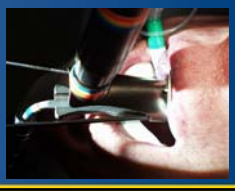


Technique – Laryngoscopes

Universal Modular Glottiscope





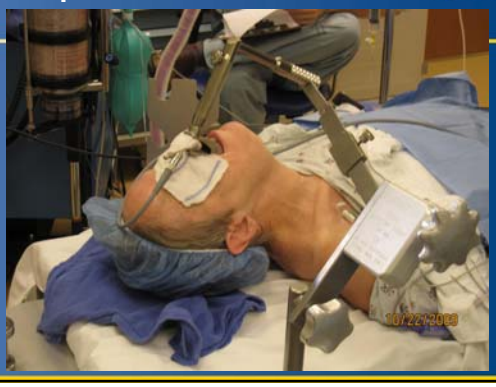
Universal Modular Glottiscope

- "Modular"
  - Different size scopes for different size patients
  - Can adapt to different suspension arms
- Triangular to best expose anterior commissure
- Side ports for instrument placement
  - Support for the instrument → shorter lever arm
  - Laterally placed for unobstructed view

Zeitels SM. Universal modular glottiscope system: the evolution of a century of design and technique for direct laryngoscopy. Ann Otol Rhinol Laryngol Suppl. 1999 Sep;179:2-24.

Universal Modular Glottiscope

Suspension Arm



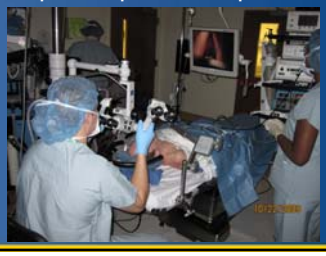
Suspension Arm

- True "suspension", not lever laryngoscopy
  - Originally described by Killian
  - Chest holders popularized in 1940's
  - Now most scopes use lever arms
- Improved vector for suspension
- "Forces on the mandible, maxilla, oral cavity, pharynx, and larynx are preferable to those associated with holder-stabilizers"

Zeitels SM, Burns JA, Dailey SH. Suspension laryngoscopy revisited. Ann Otol Rhinol Laryngol. 2004 Jan;113(1):16-22.

Suspension

- Couple true suspension with the use of 1" silk tape to optimize exposure



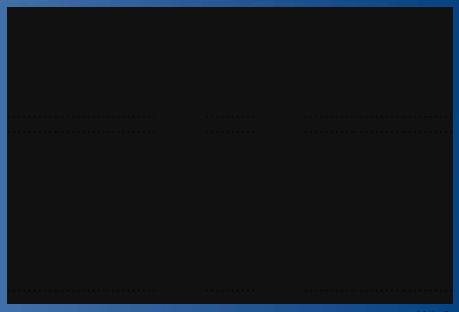
Infusion Needle

Infusion Needle

- Diagnostic
  - Degree of expansion helps predict depth of lesion / density of intra-SLP scarring

- Therapeutic
  - Tense the cord for cordotomy
  - Expand SLP to limit scarring
    - SLP twice as thick → scar proportionally half as much
  - Add epinephrine for hemostasis

Infusion Needle



infusion-Garoufalis.mpg

JOHNS HOPKINS MEDICINE

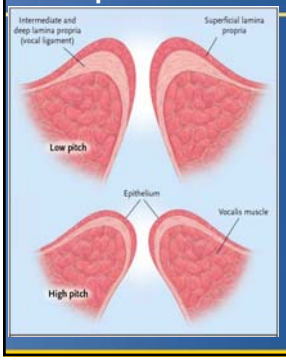
Surgical Techniques

Principles of Phonosurgery

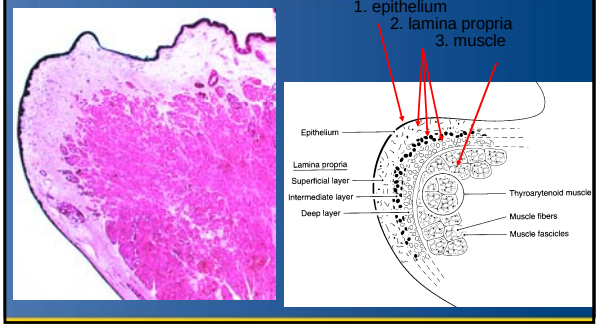
- "Phonosurgery" – surgery with attention to improvement and preservation of voice

- Exposure, exposure, exposure
- Save superficial lamina propria
- Save epithelium
- "Aim small, miss small"
  → magnification

Normal Voice – Superficial Lamina Propria



SLP, SLP, SLP



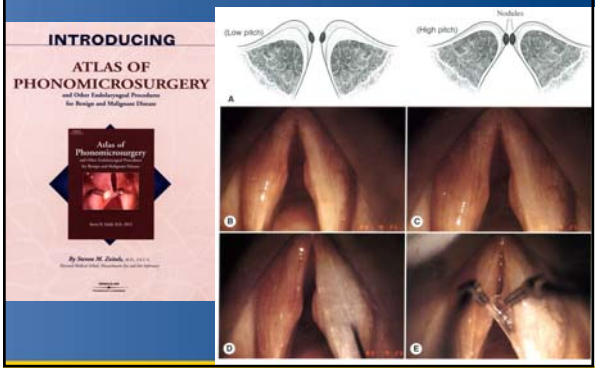
Benign Lesions – Phonomicrosurgical Resection

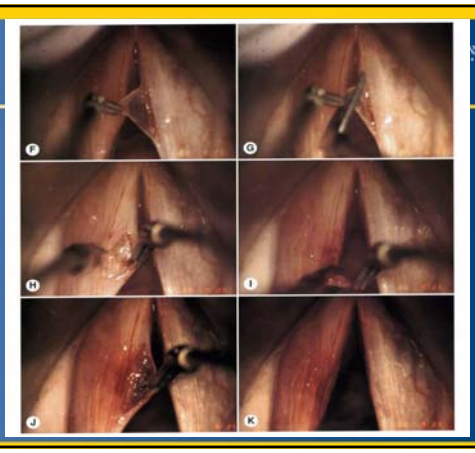
- Subepithelial lesion → subepithelial dissection
  - Cordotomy approach
  - Work on deep side of lesion first
    - More important plane is deep, to save SLP
  - Dissect epithelial attachments next
    - Minimize cordotomy defect, save epithelium to minimize scarring

Bilateral lesions – a pointer

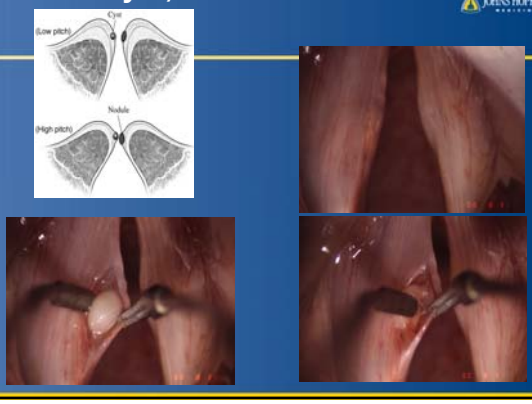
- Work on the larger (ie, more problematic) lesion first
- Based on how things go, be prepared to stage the other side
  - Let the patient know about this possibility ahead of time
  - Goal is not to place *both* TVC at risk of surgical injury unless there is confidence that the first side has healed (or will heal) well

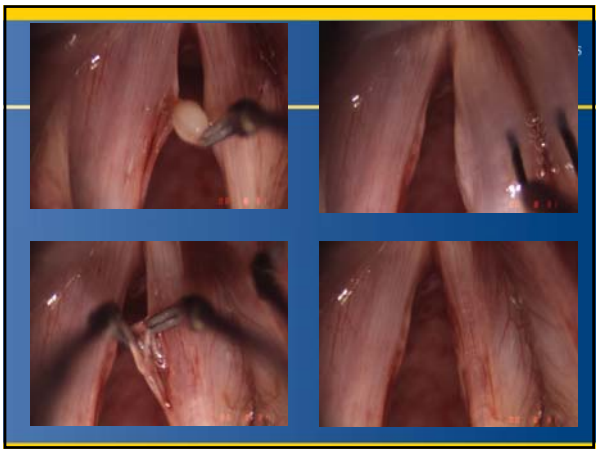
Nodules

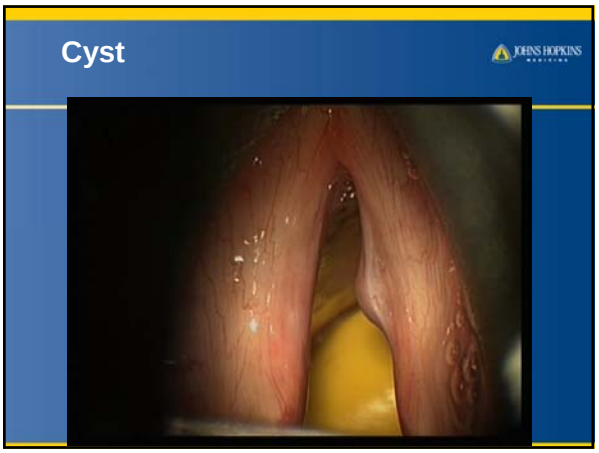


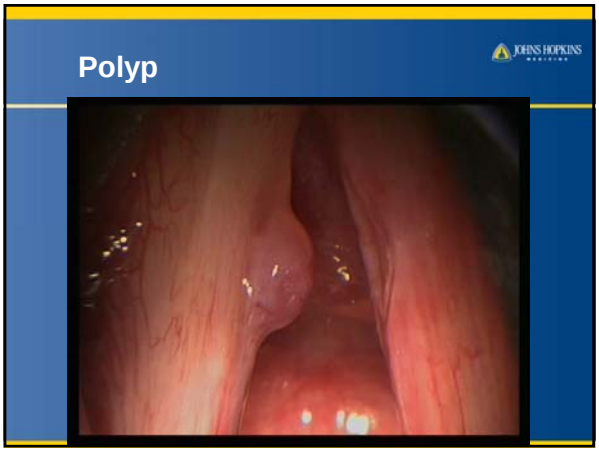


Cyst, Nodule






Cyst
JOHNS HOPKINS


Polyp
JOHNS HOPKINS

Billing & Coding

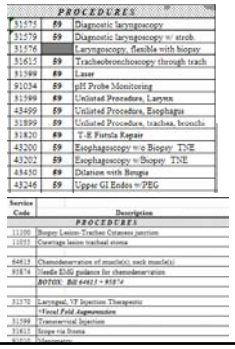
Lee Akst, M.D.
Kenneth C. Fletcher, M.D.
Barbara Messing, M.A., CCC-SLP, BRS-S

April 9, 2011
The Milton J. Dance, Jr. Head & Neck Center
The Johns Hopkins Voice Center at GBMC

The Milton J. Dance, Jr. Head & Neck Center
Johns Hopkins Voice Center at GBMC

Physician Billing and Coding

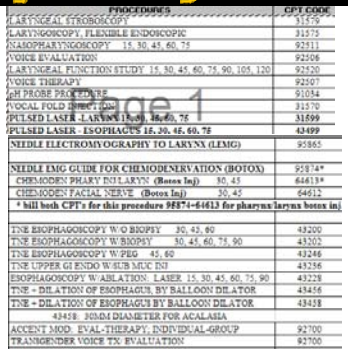
Service Code	Circle Modifier	Description
99202	25	Office outpatient visit, new
99203	25	Office outpatient visit, new
99204	25	Office outpatient visit, new
99205	25	Office outpatient visit, new
99212	25	Office outpatient visit, est
99213	25	Office outpatient visit, est
99214	25	Office outpatient visit, est
99215	25	Office outpatient visit, est
99251	25	Initial inpatient consult, Level 1
99252	25	Initial inpatient consult, Level 2
99253	25	Initial inpatient consult, Level 3
99254	25	Initial inpatient consult, Level 4
99255	25	Initial inpatient consult, Level 5
99261	25	Follow-up inpatient consult, Level 1
99262	25	Follow-up inpatient consult, Level 2
99263	25	Follow-up inpatient consult, Level 3
31599	25	Unlisted procedure, larynx



		PROCEDURES
31575	59	Diagnostic laryngoscopy
31579	59	Diagnostic laryngoscopy w/ strob
31576		Laryngoscopy, flexible with biopsy
31615	59	Tracheobronchoscopy through trach
31599	59	Laser
91034	59	pH Probe Monitoring
31599	59	Unlisted Procedure, Larynx
43499	59	Unlisted Procedure, Esophagus
31899	59	Unlisted Procedure, trachea, bronchi
31820	59	T-E Fistula Repair
43200	59	Esophagoscopy w/o Biopsy TNE
43202	59	Esophagoscopy w/Biopsy TNE
43450	59	Dilation with Bougie
43246	59	Upper GI Endos w/PEG

Service Code	Description
	PROCEDURES
31300	Biopsy Lesion-Trachea Cutaneous junction
31855	Curettage lesion tracheal stoma
64612	Chemodenervation of muscle(s); neck muscle(s)
95874	Needle EMG guidance for chemodenervation
	BOTOX: Bill 64612 + 95874
31570	Laryngeal, VF Injection Therapeutic
	*Vocal Fold Augmentation
31598	Transcervical Injection
31615	Scope via Stoma

SLP Hospital Out patient clinic Billing and coding



PROCEDURES	CPT CODE
LARYNGEAL STROBOSCOPY	31579
LARYNGOSCOPY, FLEXIBLE ENDOSCOPIC	31575
NASOPHARYNGOSCOPY 15, 30, 45, 60, 75	92511
VOICE EVALUATION	92506
LARYNGEAL FUNCTION STUDY 15, 30, 45, 60, 75, 90, 105, 120	92520
VOICE THERAPY	92507
pH PROBE PROCEDURE	91034
VOCAL FOLD INJECTION	31570
PULSED LASER -LARYNX 15, 30, 45, 60, 75	31599
PULSED LASER - ESOPHAGUS 15, 30, 45, 60, 75	43499
NEEDLE ELECTROMYOGRAPHY TO LARYNX (LEMG)	95865
NEDDLE EMG GUIDE FOR CHEMODENERVATION (BOTOX)	95874*
CHEMODEN PHARY INJ LARYN (Botox Inj) 30, 45	64613*
CHEMODEN FACIAL NERVE (Botox Inj) 30, 45	64612
* bill both CPT's for this procedure 95874+64613 for pharynx/larynx botox inj	
TNE ESOPHAGOSCOPY W/O BIOPSY 30, 45, 60	43200
TNE ESOPHAGOSCOPY W/BIOPSY 30, 45, 60, 75, 90	43202
TNE ESOPHAGOSCOPY W/PEG 45, 60	43246
TNE UPPER GI ENDO W/SUB MUC INJ	43256
ESOPHAGOSCOPY W/ABLATION LASER 15, 30, 45, 60, 75, 90	43228
TNE + DILATION OF ESOPHAGUS, BY BALLOON DILATOR	43456
TNE + DILATION OF ESOPHAGUS BY BALLOON DILATOR	43458
43458: 30MM DIAMETER FOR ACALASIA	
ACCENT MOD. EVAL-THERAPY, INDIVIDUAL-GROUP	92700
TRANSGENDER VOICE TX EVALUATION	92700

http://www.asha.org/uploadedFiles/2011-Medicare-Fee-Schedule-SLPs.pdf

2011 Medicare Fee Schedule
for Speech-Language Pathologists

www.asha.org

- **ICD-10-CM Diagnosis Codes for Audiology and Speech-Language Pathology (International Classification of Diseases, 10th Revision, Clinical Modification)**
- Beginning **October 1, 2013**, you will be required to use the new ICD-10 system, which will replace the current ICD-9-CM (International Classification of Diseases, 9th Revision, Clinical Modification) Volumes 1, 2, and 3 used to report health care diagnoses, disorders, and inpatient hospital procedures. The new ICD-10 will include the ICD-10-CM (clinical modification) for diagnosis codes and the ICD-10-PCS (procedure coding system) for inpatient hospital procedures. This page will focus primarily on ICD-10-CM.
- *The codes in ICD-10 are not valid for any purpose or use in the United States until October 1, 2013.*

Advanced Cold Instrument Surgery

Kenneth C. Fletcher, Jr., MD

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Johns Hopkins Voice Center at GBMC

Microflap Approach

- Submucosal Pathology
  - Make incision through the epithelium at the closest possible location to the submucosal pathology

Microflap Approach

- Submucosal Pathology
  - Disrupt the minimum surrounding tissue to the vocal fold pathology

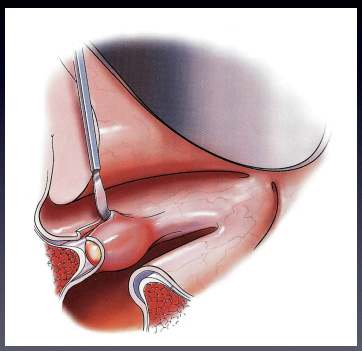
Microflap Approach

- Submucosal Pathology
  - Stay as superficial as possible

Microflap Approach

- Submucosal Pathology
  - Preservation of overlying normal mucosa (epithelium plus superficial lamina propria)

Cyst



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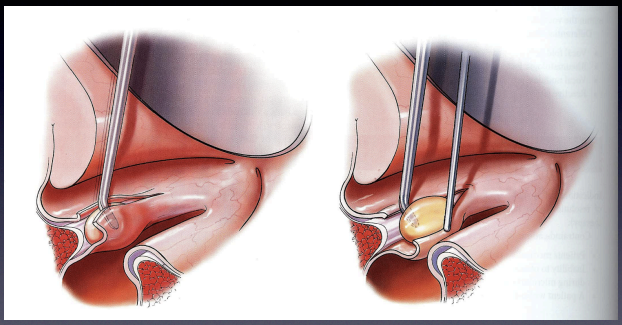

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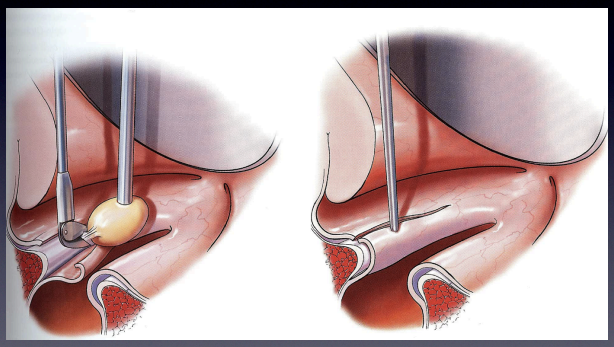

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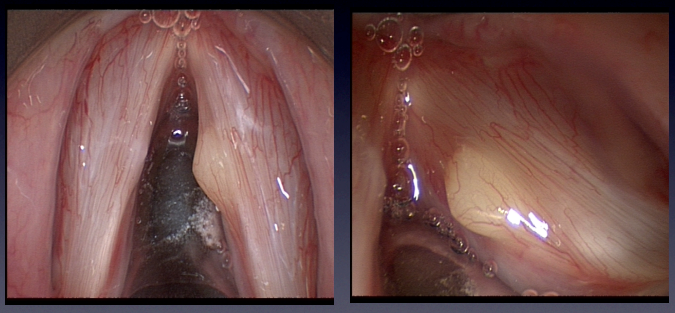

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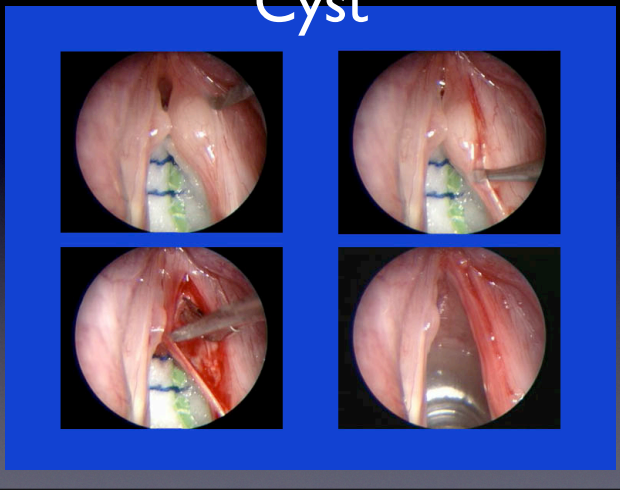

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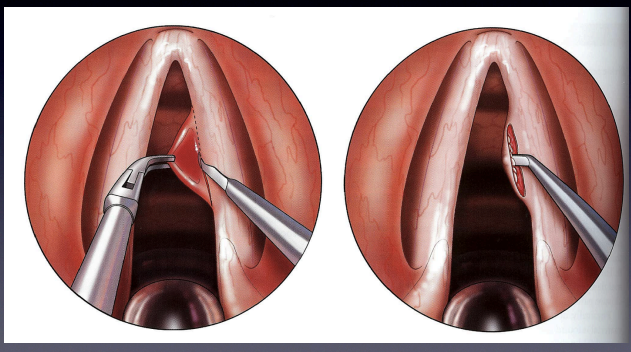

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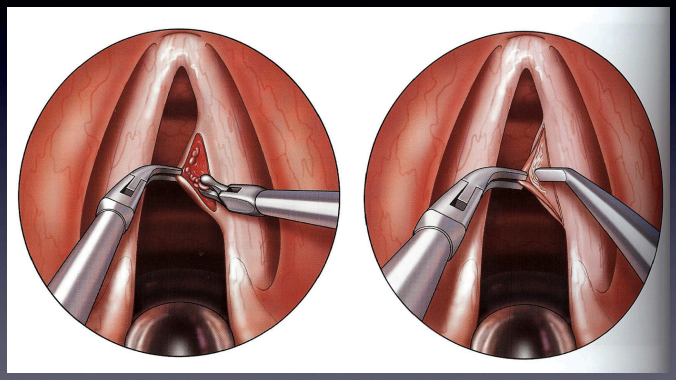

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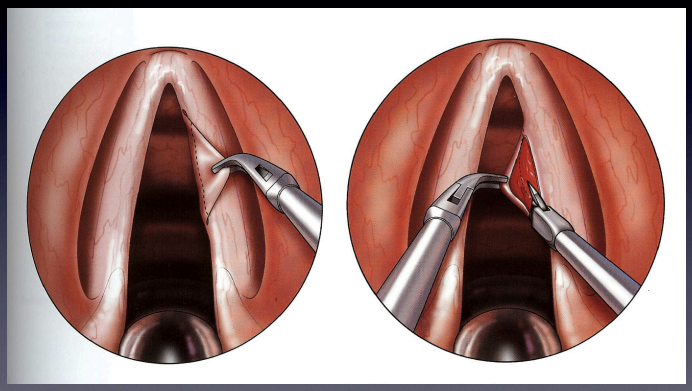

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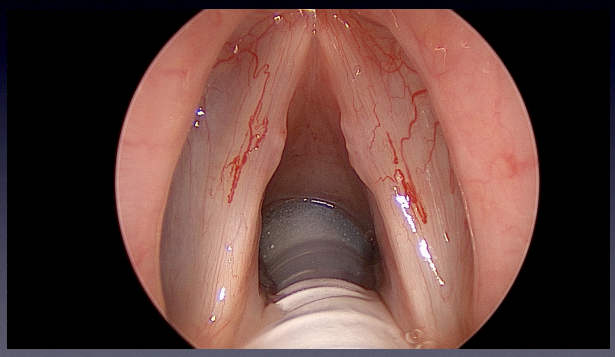

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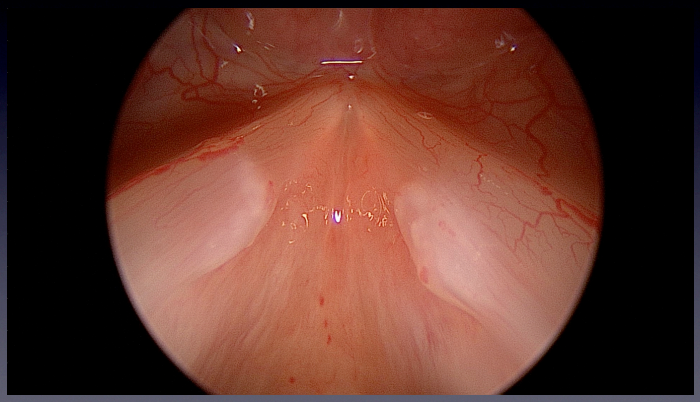

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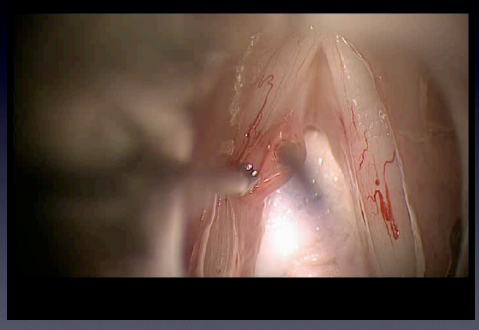

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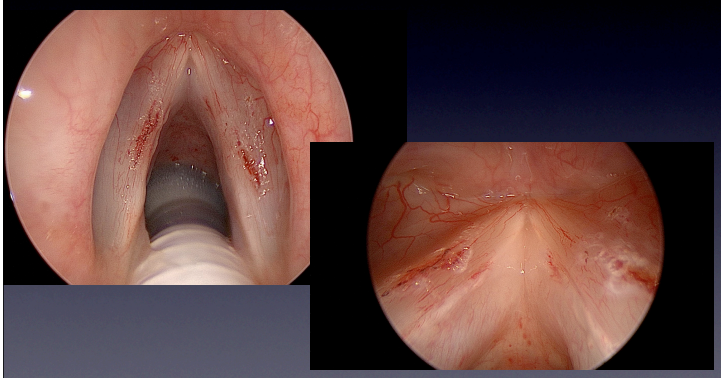
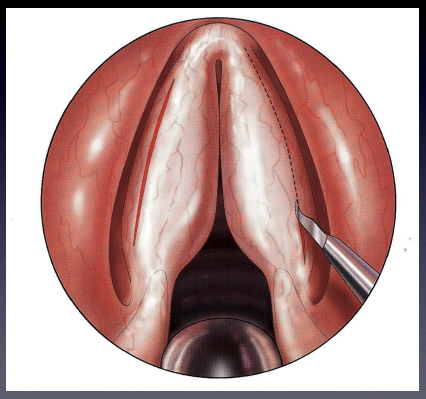
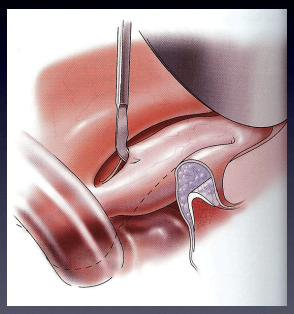


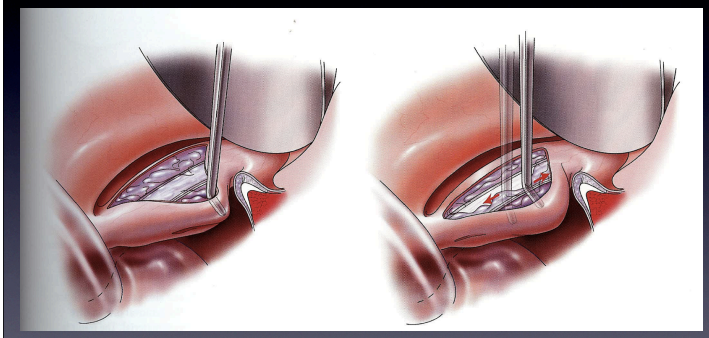
Polypoid Corditis



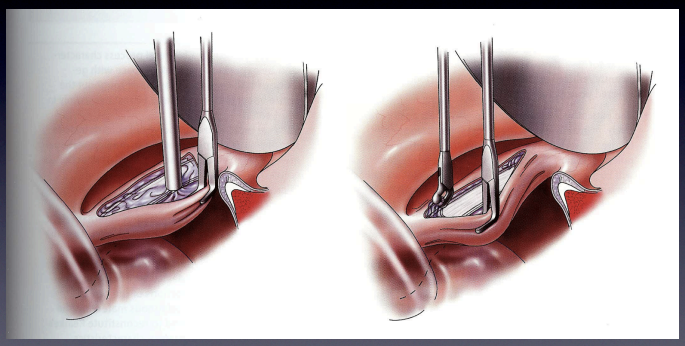
Polypoid Corditis



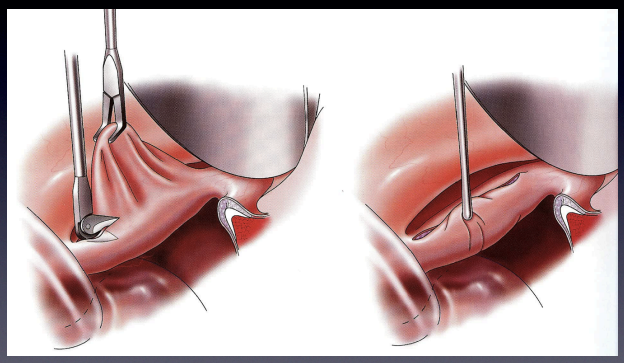
Polypoid Corditis



Polypoid Corditis



Polypoid Corditis



Laryngeal EMG & Botox

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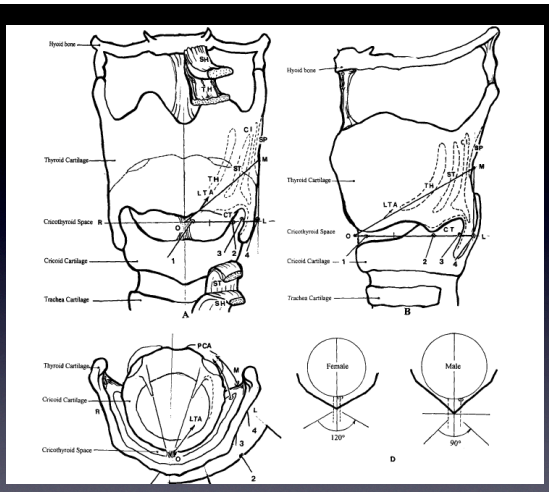
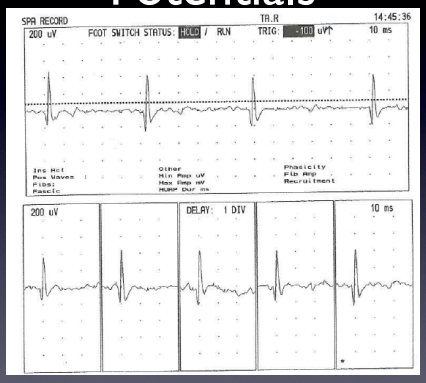
Laryngeal EMG

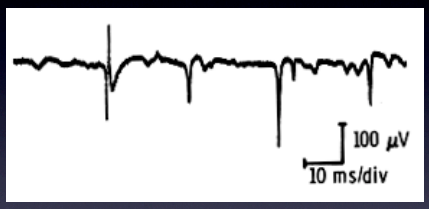
- Described as early as 1944 by Weddell
- Evolved into study to analyze peripheral recurrent nerve injury
- CNS diagnoses: myasthenia gravis, Charcot-Marie Tooth, laryngeal dystonia
- Aid in injection of Botox for Spasmodic Dysphonia - Tremor



Normal Motor Unit Action Potentials

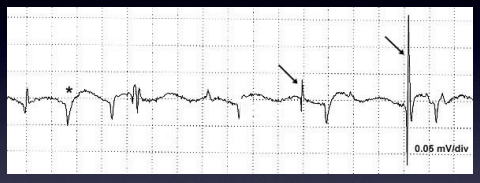


Fibrillation Potentials



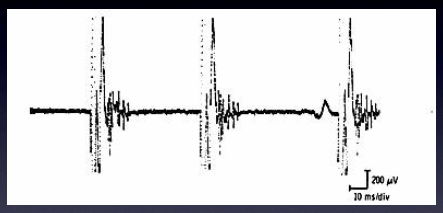
Recent or ongoing degeneration

Positive Sharp Waves



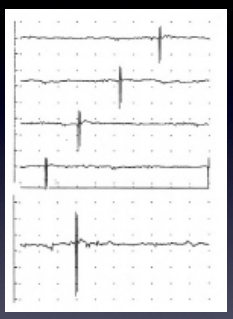
Seen along with fibrillation potentials indicating recent or ongoing degeneration

Polyphasic Potentials



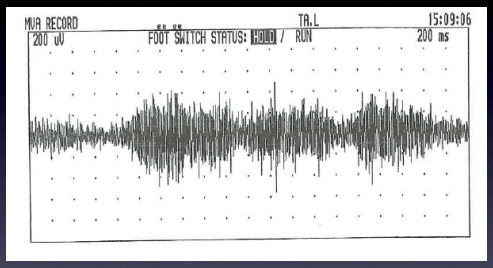
Reinnervation is occurring and may be a sign of recovery

Large Amplitude Motor Unit

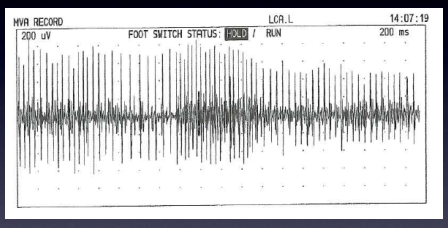


Sign of stability of reinnervation

Normal Recruitment

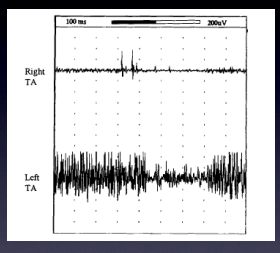


Few Motor Units Firing Fast



Peripheral nerve injury with fewer motor units firing

Spontaneous and Irregular Recruitment



Spasmodic Dysphonia

EMG

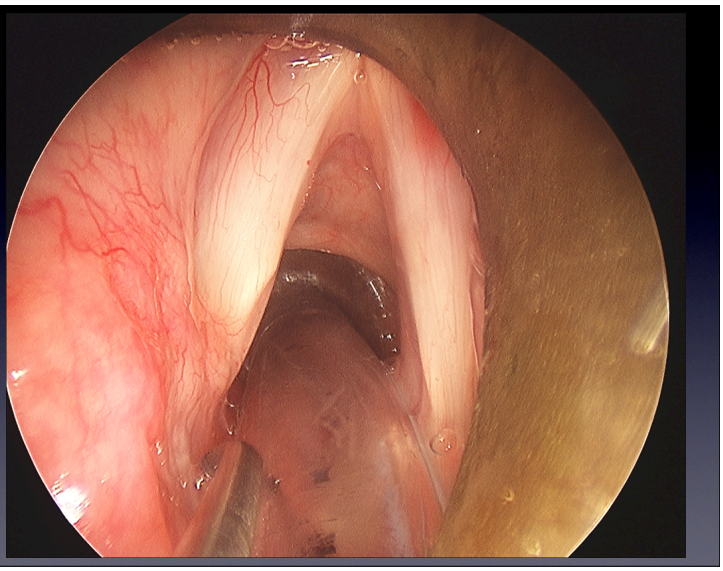
- Diagnostic interpretation of the EMG usually done in conjunction with a neurologist trained in EMG interpretation
- Sometimes seen as a "art form"

Laryngeal EMG

- Determine the state of the recurrent laryngeal nerve in the setting of vocal fold immobility

Laryngeal EMG

- Determine the state of the recurrent laryngeal nerve in the setting of vocal fold immobility and possibility of cricoarytenoid joint dislocation* or scarring in the setting of an laryngeal injury



Laryngeal EMG

- Determine the state of the cricothyroid muscle and the superior laryngeal nerve if there is suspicion for injury

Laryngeal EMG

- Allow monitoring for vocal fold injection for spasmodic dysphonia and/or tremor

Botulinum Toxin

- Indications
  - Spasmodic Dysphonia
    - Adductor
    - Abductor
    - Mixed

Botulinum Toxin

- Indications
  - Essential Tremor
    - Horizontal versus vertical
    - Isolated laryngeal versus laryngopharyngeal

Botulinum Toxin

- Indications
  - Vocal fold granuloma
    - forced voice rest

Botulinum Toxin

- Indications (relative)
  - bilateral vocal fold paralysis
  - Vocal cord dysfunction

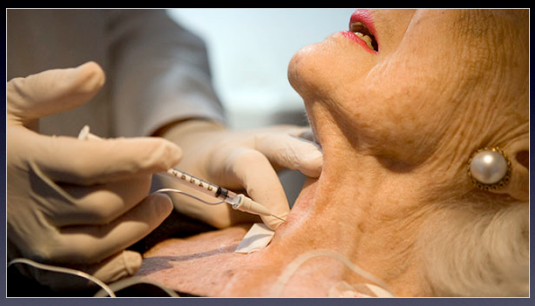
Botulinum Toxin

- Dosing:
  Adductor Spasmodic Dysphonia:
  - Start at 1.25 U per side and escalate
  Abductor Spasmodic Dysphonia:
  - Unilateral 5 U dose with contralateral side titrated after observation for 2 weeks
  - Risk of bilateral paralysis and airway obstruction
  Granuloma
  - Usually unilateral 5-20 U

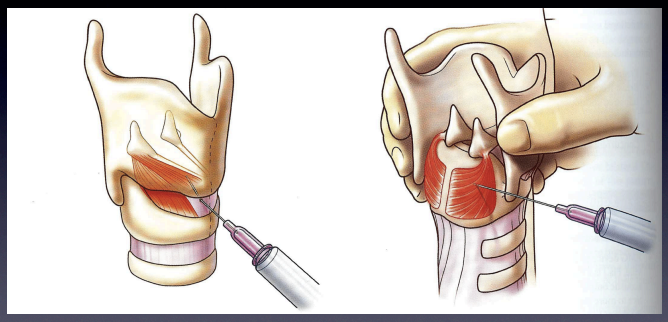
Botulinum Toxin

- Contraindications to injection:
  - Preganancy
  - Breast feeding
  - Impaired function of vocal fold for PCA injection (relative)
  - Concurrent aminoglycoside treatment

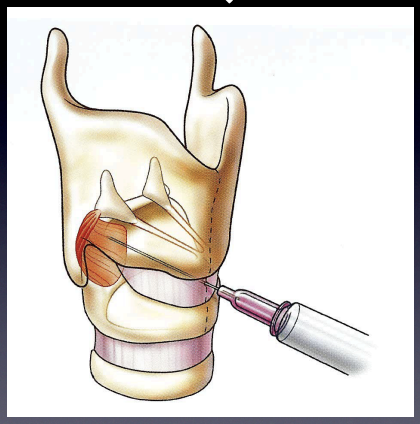
Botox injection



Botox injection



Botox injection



Laryngeal Framework Surgery

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Johns Hopkins Voice Center at GBMC

Indications

- Vocal Fold Immobility of permanent nature
- Bilateral intervention for paresis/ presbylarynges

Anesthesia

- Local Only
  - Marcaine + Lidocaine
- Propofol for injection of local
- Tetracaine for nasal cavity (fiberoptic scope)
- Try to avoid anxiolytics
  - Versed, Valium
- Small amounts of Fentanyl for discomfort

Operative Considerations

- Shoulder Roll
- Fiberoptic scope in place for directed visualization of the vocal fold
- Meticulous dissection to prevent swelling of vocal fold
  - Bipolar cautery

Laryngeal Framework Surgery

- Medialization Laryngoplasty
- Arytenoid Adduction
- Cricothyroid Subluxation

Laryngeal Framework Surgery

- Timing:
  - at least 6-12 months following injury
  - LEMG
  - at least 4 months following temporary injection (Cymetra / Radiesse Voice)

Laryngeal Framework Surgery

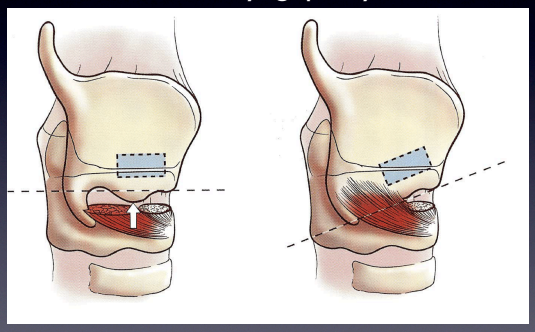
- Medialization Laryngoplasty
  - Silastic
  - Gore-tex
  - Hydroxylapatite
  - Titanium "spring"

Laryngeal Framework Surgery

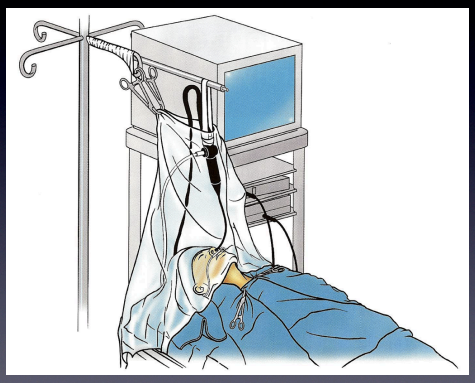
- Medialization Laryngoplasty
  - Silastic - technique I prefer as classically performed and described by Netterville using carved silastic
    - Advantages: specifically able to tailor the implant for each individual patient
    - Disadvantages: steep learning curve

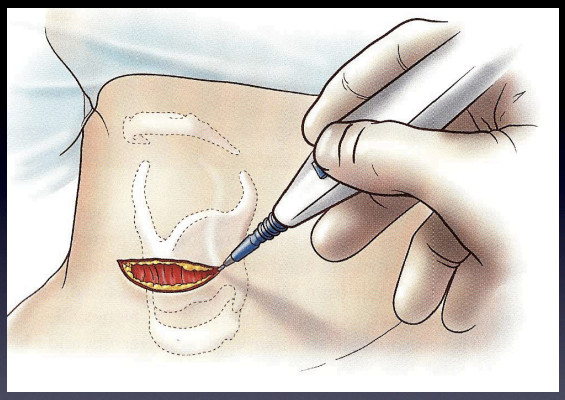
Laryngeal Framework Surgery

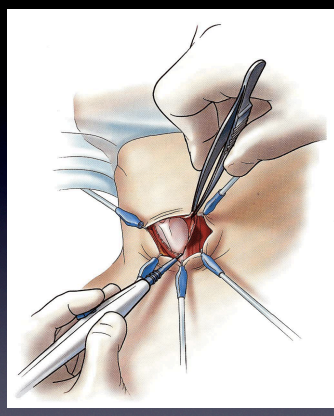
- Medialization Laryngoplasty

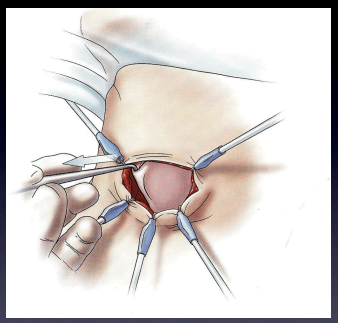


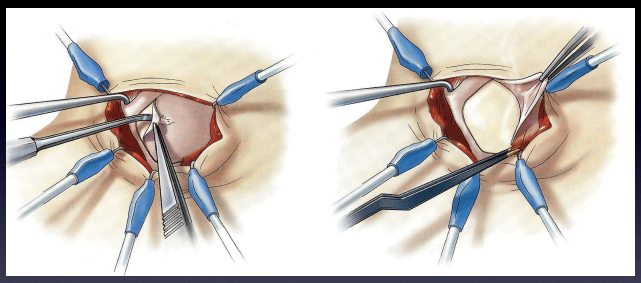
Patient Positioning

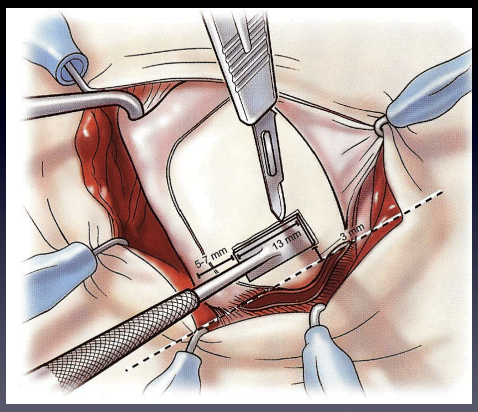








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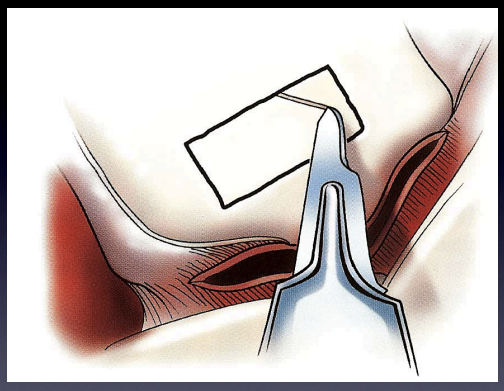
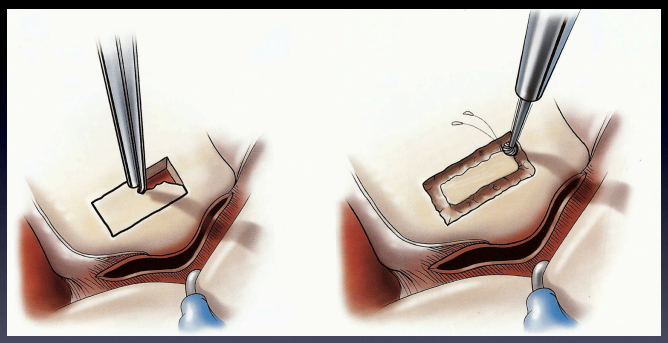
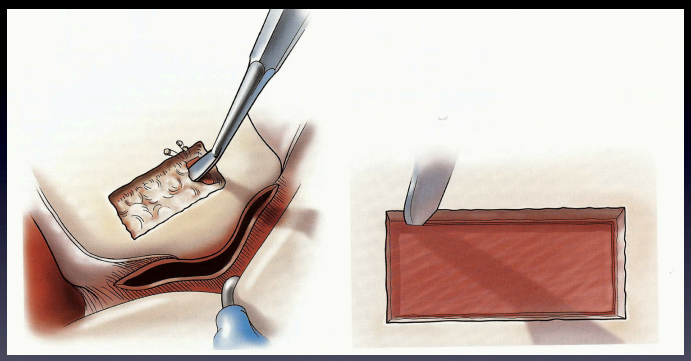
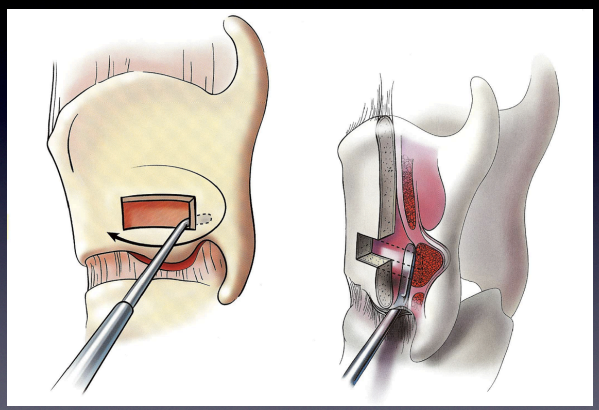
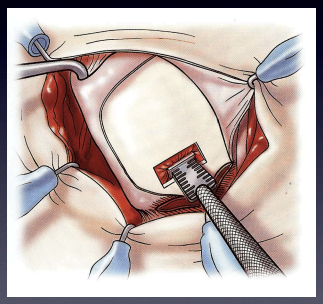
13 mm
3 mm

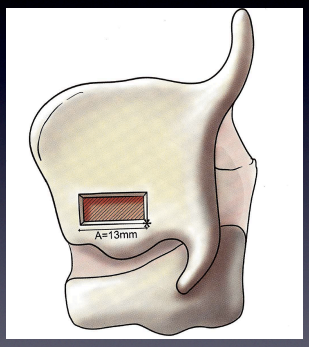








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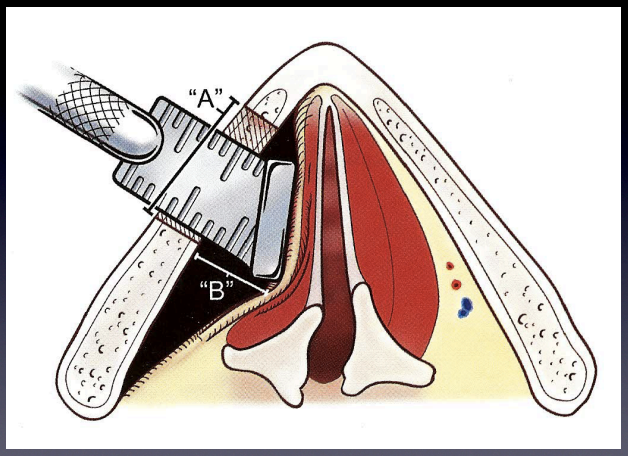
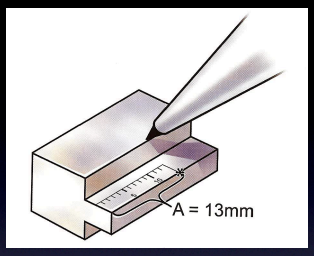
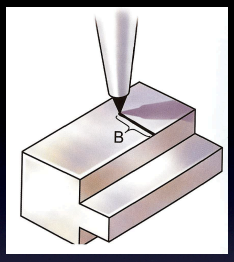

"A"
"B"


A = 13mm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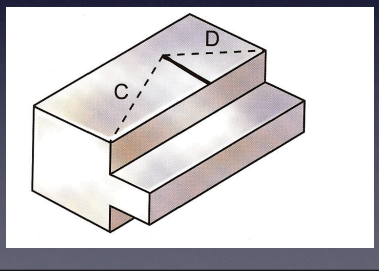
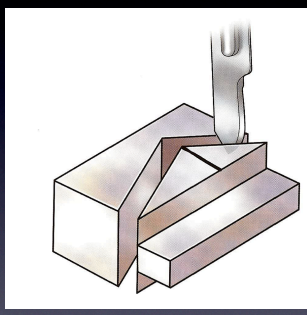
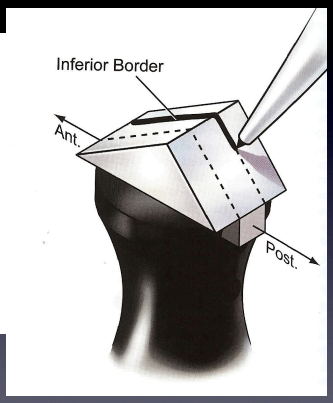

C
D

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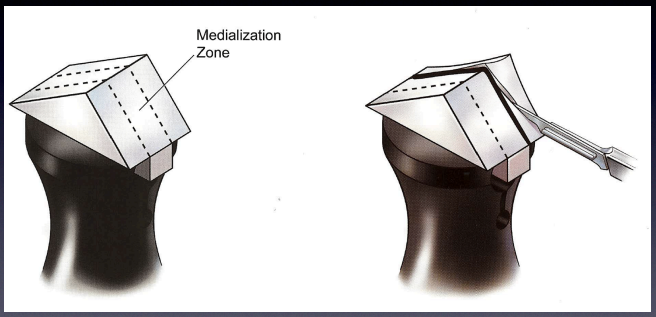
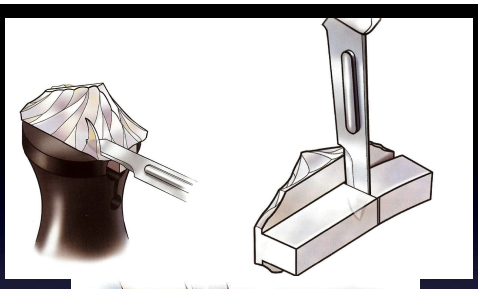
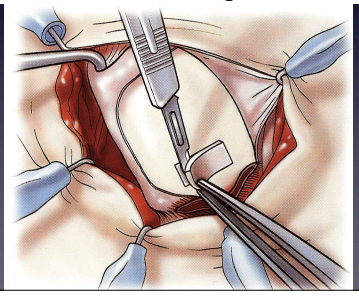

Medialization
Zone

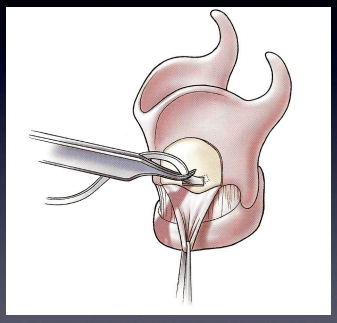


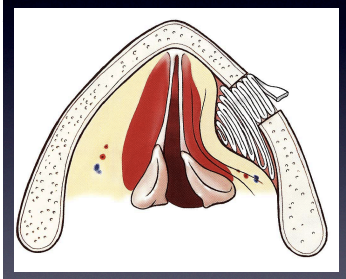


Laryngeal Framework Surgery

- Medialization Laryngoplasty
  - Gore-Tex - uses a Gore-Tex strip layered through a small thryrotomy
    - Advantages: fast, technically easier than silastic
    - Disadvanatages: Harder to fine-tune, implant can change position with time, migration

Gore-Tex





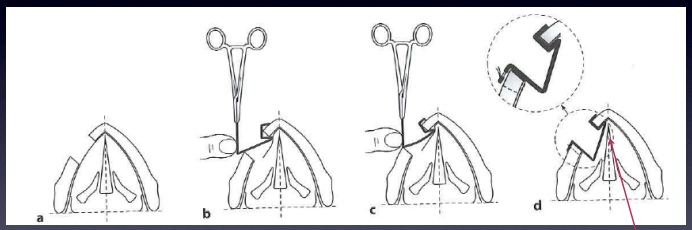
Laryngeal Framework Surgery

- Medialization Laryngoplasty
  - Hydroxylapatite - preformed blocks
    - Application similar to carved silastic however blocks are much larger
    - Advantages: preformed
    - Disadvantages: multiple sizes available that are not customizeable, often allows too much anterior medializtion

Laryngeal Framework Surgery

- Medialization Laryngoplasty
  - Titanium "spring" - preformed spring made by Gyrus/Kurz
  - Advantages: Preformed implant, faster OR time, can be standardized with less experienced surgeons
  - Disadvantages: implant is large (3 sizes), may provide medialization at wrong cord position

TVFMI = Titanium Vocal Medialization Implant



Sizes: 6x11 mm, 6x13 mm, & 4.5 x 9 mm

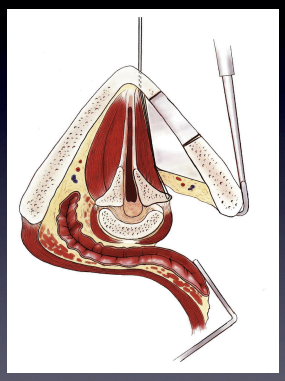
Considerable Anterior Medialization
Which is not favorable

Arytenoid Adduction

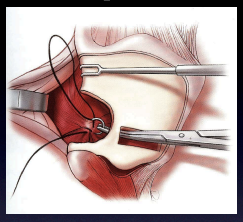
- Lengthens the paralyzed vocal fold
- Attempts to recreate the rotation and downward displacement of the vocal fold ("off-level")

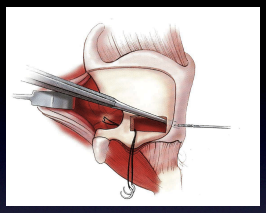
- Does not need to be done in every situation
- Determined at time of surgery (1 in 5) if medialization alone does not achieve the desired voice

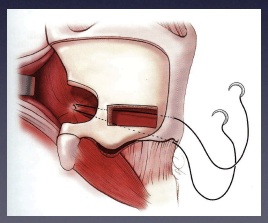
Arytenoid Adduction

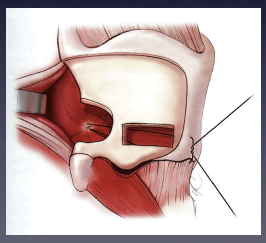


Arytenoid Adduction





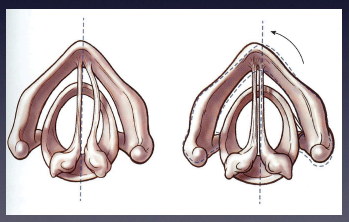


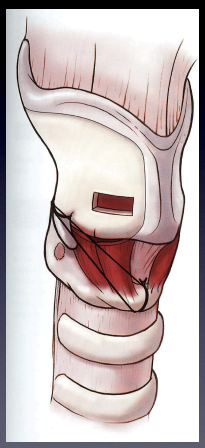


Cricothyroid Subluxation

- Designed to also lengthen the vocal fold and "remove laxity"

Cricothyroid Subluxation





Laser Safety

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Laser Safety

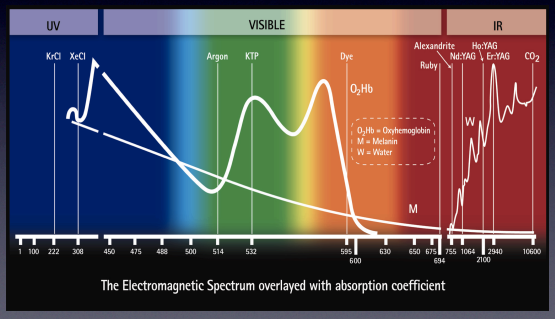
- Safety goggles must be worn by
  - Surgeon
  - Operating room personnel
  - Patient (if awake)

Laser Safety

- Eye Protection
- Inhaled Smoke Protection

Laser Saftey

- Eye Protection

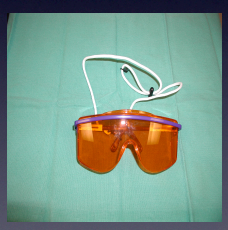


The Electromagnetic Spectrum overlayed with absorption coefficient

Laser Safety

- Warning signs must be posted
- Signs must indicate power and wavelength
- For the Aura XP sign should read "Max. of 15 W at 532 nm"
- Doors to treatment room are closed
- Goggles: O.D. 5 @ 532 nm (KTP)

- ANSI Standard Z.136.3 recommends that ALL personnel in the O.R. wear protective eyewear to prevent accidental eye damage
- The eye is most vulnerable part of body with regard to laser injury
- KTP can cause retinal damage



Laser Safety

- All personnel must be trained on specific use for each laser prior to use
- Laser key must never be left in laser other than when in use
- Turn laser to "Standby" when removing fiber from scope
- Communicate "Ready" and "Standby" to Surgeon prior to firing

Surgical Smoke

- Lasers and electrosurgical cautery

Smoke

- Odor
  - Pyrolysis
    - Acrolein, Acetonitrile, Acetylene, Alkyl benzenes, Butadiene, Butene, CO, Creosols, Ethane, Ethylene, Formaldehyde, Free radicals, HCN, Isobutene, Methane, Phenol, Polycyclic aromatic hydrocarbons, Propene, Propylene, Pyridene, Pyrrole, Styrene, Toluene, Xylene

Smoke

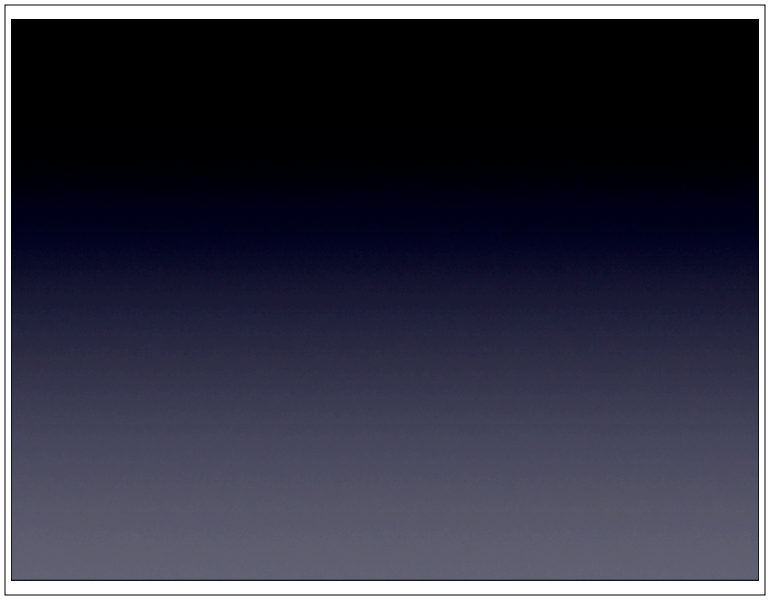
- Size of particulate matter
  - 1.1 microns
  - surgical masks (0.5 microns)
  - high filtration masks (0.1 microns)

Smoke

- Viability of Particulate Matter
  - Bacteria
  - Cells
  - Viruses
    - Documented transmission of HPV to surgeon (anogenital to laryngeal)

Smoke

- Inline smoke evacuator
  - Red-rubber catheter through opposite nasal cavity
  - Activated during laser activation



Office-Based Anesthesia

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Topical Anesthesia

- Laryngovideostroboscopy
- In-office vocal fold injection
- Transnasal fiberoptic laser surgery
- Transnasal esophagoscopy

Laryngovideostoboscopy

- No anesthesia
- Cetacaine
- Transnasal (aerosolized 4% lidocaine)

In-office vocal fold injection

- Route of injection
  - Peroral
  - Transcutaneous
    - Transthyrohyoid
    - Transthyroid
    - Transcricothyroid

In-office vocal fold injection

- Route of injection
  - Peroral (4% Lidocaine +/- Cetacaine)
    - Curved Abraham Canula
    - Via port on flexible fiberoptic scope
    - Nebulization

In-office vocal fold injection

- Route of injection
  - Transcutaneous
    - All require similar internal anesthesia
    - Also require local site injection usually of 1% lidocaine with epinephrine

Transnasal fiberoptic laser surgery

- Administration essentially the same as for vocal fold injection

In-office vocal fold injection Transnasal fiberoptic laser

- Application of Anesthesia
  - Cetacaine spray
  - 4% Lidocaine
    - ~ 1 cc tongue base
    - ~ 2 cc epiglottis
    - ~ 2 to 4 cc on phonating vocal folds

4% Lidocaine

- The maximum recommended single dose is approximately 7-8 cc
- 4.5 mg/kg
- ~ 300 mg in a 70 kg patient
- Consider this in patients with cardiac disease

Transnasal Esophagoscopy

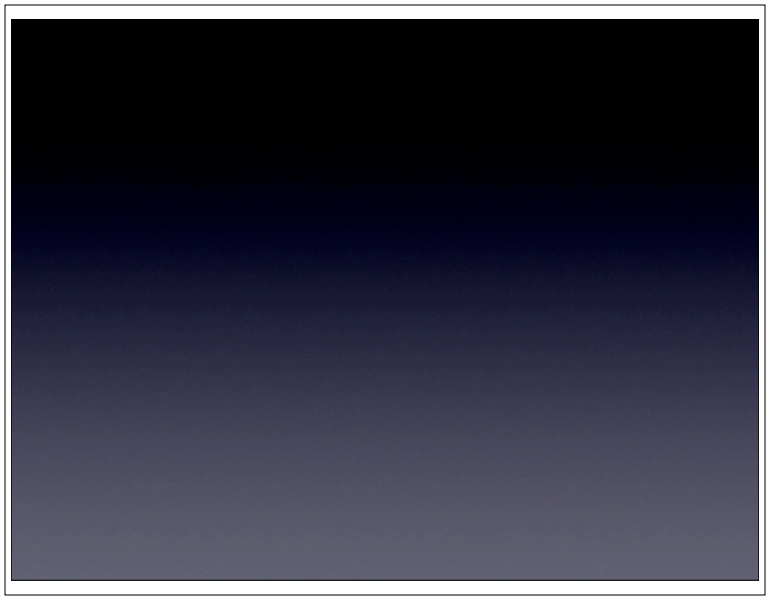
- Topical Nasal Anesthetization Only
- Ensure both nasal cavities are thoroughly aerasolized

Anesthesia

- A good anesthetic provides the ability to perform the procedure while limiting side affects that make the procedure more difficult
  - Globus sensation - heightened gag
  - Pooling of secretions

Post-anesthesia

- Patient is reassured that anesthesia will be short-lived and any symptoms of globus, dysphagia will resolve within 1 hour following the procedure
- Patient advised not to eat or drink for the period during which sensation recovers (1-2 hours)



Perioperative Medications and Management

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Anticoagulation Medications

- NSAIDS
- ASA
- Coumadin
- Plavix
- Dong quai, primrose, vitamin E, garlic, gingko, ginger, feverfew, red root

Anticoagulation Medications

- For phonomicrosurgical cases and open laryngeal cases stop 7-10 days
- For direct microlaryngosocopy with biopsy or vocal fold injection generally does not require cessation
- In-office injections generally do not require cessation

Prophylaxis

- Proton-pump inhibitor therapy -
  - Generally advised even without symptoms of laryngopharyngeal reflux to ensure no added inflammation
  - GERD dietary habits discussed
  - Often extended 1-2 months following phonomicrosurgery
  - Debateable

Steroids

- Oral Steroids
  - May be considered preoperatively if surrounding edema present may be masking lesion
  - Not routinely used
  - No routine post-operative role

Steroids

- Dexamethasone IV (10-20 mg):
  - For all general laryngeal cases
  - Prior to induction of general anesthesia
  - No role for extended use following phonomicrosurgery
  - Not usually employed in office-based procedures

Steroids

- Dexamethasone 10 mg/ml
  - Can be used intralesionally for vocal fold scar
  - Can be used after phonomicrosurgery should stiffness not improve with expected surgical healing
  - Avoid Kenalog due to particle deposits within vocal fold

Antibiotics

- No role for prophylactic antibiotics in phonomicrosurgical cases
- Ancef or equivalent used for open laryngeal framework surgery especially if implant being used

Narcotics

- e.g. Hydrocodone -
  - Allows for postoperative pain control (usually minimal)
  - Functions as an anti-tussive

Preoperative Counseling and Informed Consent

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Phonomicrosurgery

- Usually Elective Surgery
- Primary Goal is to improve voice quality
- Reserved for cases where all conservative measures have been exhausted

Phonomicrosurgery

- Timing:
  - Discuss need for adequate recovery
  - Voice rest - ~ 1 week
  - Full speaking - 7 to 30 days
  - Full singing - 30 to 90 days

Phonomicrosurgery

- Timing:
  - Demands for return
    - Intrinsic
    - Extrinsic
  - e.g. school teachers and summer break
  - e.g. college students after college

Preoperative Considerations

- Reduce vocal edema 1-2 weeks prior to surgery (Reduce heavy voice use)
- Control premorbid conditions
  - Reflux
  - Allergies

Preoperative Considerations

- Analyze psychological impact
  - Identification of "self" with voice
  - Performers
  - Discuss this possible anxiety prior to surgery

Preoperative Considerations

- Preoperative voice therapy
  - Helps determine if surgery is necessary due to impasse in progress
  - Allows time to accept need for surgery
  - Helps ensure best recovery

Preoperative Considerations

- Usually Elective
  - Do not delay if...
    - Dysphagia associated with aspiration
    - Impending airway embarassment
    - Risk for malignancy

Preoperative Considerations

- Usually Elective
  - Large exophytic polyps or a lateralized paralyzed vocal fold that will not improve with therapy often benefit from a more directed surgical approach
  - Voice therapy in these cases allows for a bridge to post-operative rehabilitation

Preoperative Considerations

- The most important question that must be answered before deciding for or against proceeding with phonomicrosurgery is: "Can the patient do what they need to do with their voice after undergoing maximum of nonsurgical rehabilitation?"

Preoperative Considerations

- Once surgery is planned:
  - Videostroboscopy within 1-3 weeks of surgery

Informed Consent

- Education with Documentation
  - Discuss vocal abilities, training and post-operative voice demands

Informed Consent

- Success rate should be 95% for appropriately performed phonomicrosurgery

Informed Consent

- Important to make the distinction between voice improvement and restoration of premorbid vocal capabilities

Informed Consent

- Success dependent on:
  - Pathology
  - Patient's ability
  - Vocal demands

Informed Consent

- Discuss risk of postoperative scarring and permanent dysphonia
  - worse than preoperative status
  - 1-2 %

Informed Consent

- Risk of no improvement
  - 1-2 %

Informed Consent

- With procedures aimed at improving glottal competence
  - Discuss the difference between restoration of strength and volume and clarity and premorbid voice dynamics

Informed Consent

- With procedures where malignancy may be involved:
  - Discuss voice and swallowing affect
  - Discuss possible need for repeat procedures

Informed Consent

- With airway procedures:
  - Discuss the inverse relation of voice and breathing
  - Discuss need for repeat procedures

Informed Consent

- For all patients:
  - Discuss the airway and risk for edema
  - Remote or potential need for tracheotomy

Informed Consent

- For all patients:
  - Discuss risk to non-laryngeal structures
    - Tongue (numbness, taste alteration - may take 6 weeks to recover)
    - Teeth, lips, gums
    - Pharyngeal tears, lacerations

Informed Consent

- For all patients:
  - Discuss general risks of surgery
  - Anesthesia
    - possibility of post-operative muscle weakness and soreness due to muscle relaxants

Informed Consent

- For all patients:
  - The more time spent up front helps with questions later
  - Patients generally recall 20% of what they are told