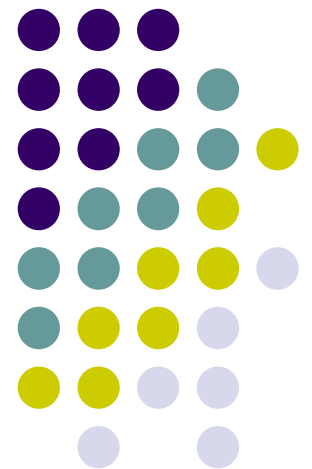


Vocal Fold Augmentation

Nov 14, 2008

Bruce Tan, MD

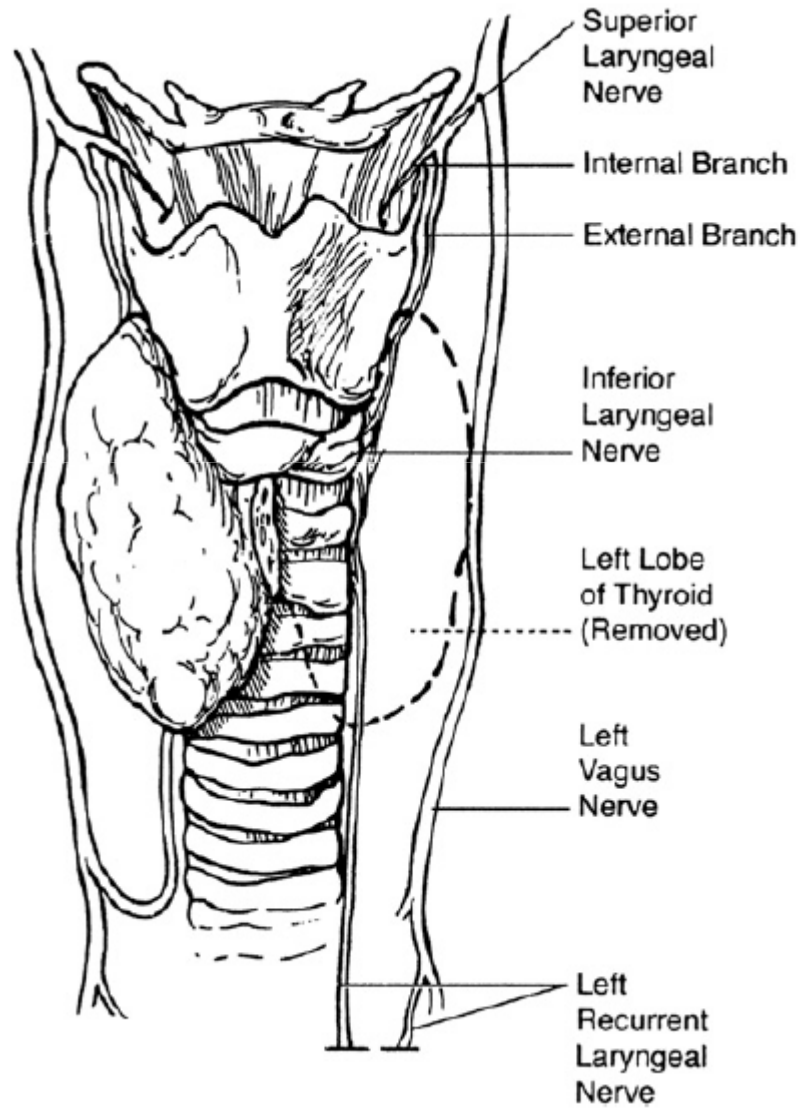
Sofia Lyford-Pike, MD



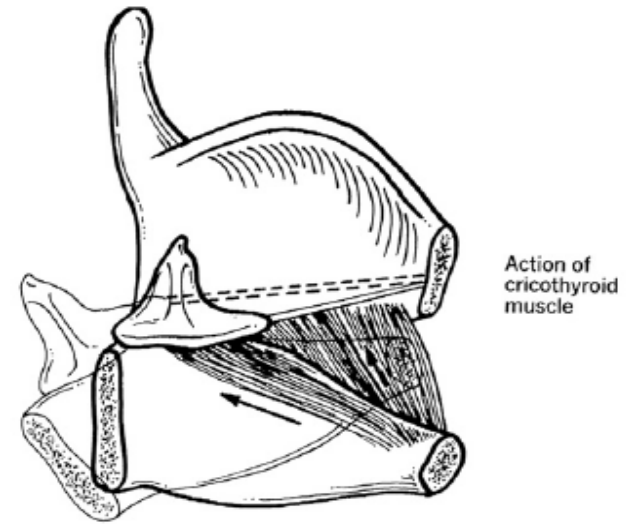


CME Objectives

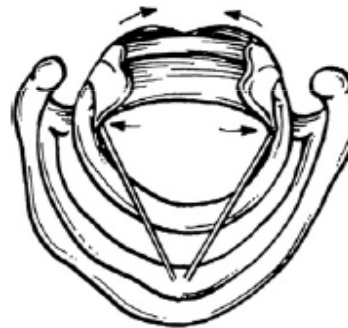
- Discuss the relevant anatomy and pathophysiology of glottic incompetence
- Discuss the use of injectable products for vocal fold medialization
- Discuss the surgical techniques available for vocal fold medialization
- Discuss the clinical outcomes of these procedures



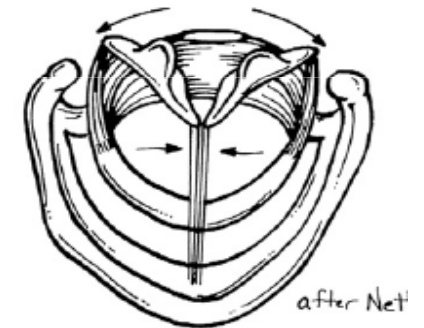
- SLN: Cricothyroid muscle
- RLN: PCA, adductors and the thyroarytenoid
- RLN de-innervation results in immediate loss of vocal fold mass, abduction, and adduction producing glottic incompetence



Action of posterior cricoarytenoid muscles



Action of lateral cricoarytenoid muscles



Action of arytenoidius muscle



Action of vocalis and thyroarytenoid muscles



Causes of glottic incompetence

- Vocal cord paralysis
- Sulcus vocalis
- Vocal fold atrophy



Symptoms of vocal fold incompetence



- Breathy, hoarse, raspy, diplophonic voice
- Decreased glottic efficiency
- Aspiration and potentially aspiration pneumonia.



Treatment Modalities

- Voice and swallowing therapy
- Vocal cord injection
- Surgery

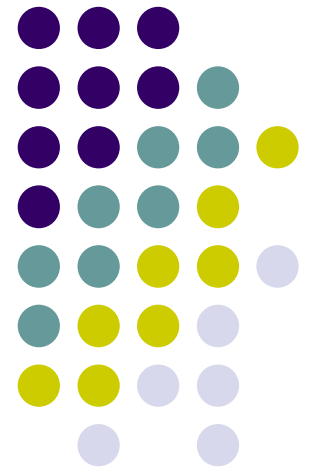
Treatment Considerations

- Severity of symptoms
- Expected duration of impairment
- Patient co-morbidities, motivation



Injection Laryngoplasty

Sofia Lyford-Pike MD
Greater Baltimore Medical Center
Grand Rounds



Vocal Fold Pathology



- Cords that cannot adduct but maintain vibratory characteristics
- Dysphonia and...
- Aspiration, ineffective cough, dyspnea on exertion
- Cords move normally but have damaged vibratory membranes
- (Atrophy, scarring, bowing)
- Principal c/o Dysphonia



The Beginning

- **1911**
Bruening injects **Parafin** to medialize an immobile cord.
-**Cons:** Inflammatory response, extrusion and migration

- **1950's**
Arnold injects **cartilage and bovine bone dust**
-**Pro:** Less inflammation
-**Con:** Resorption

These 4 facets continue to currently be the limitations in the search for the ideal injectable.

TEFLON

1960's

Use: Immobile Cord



PROS

Permanent

CONS

Inflammatory Response

→ Granulomas

Migration

Difficult Injection

(not viscous, large gauge
needle)

BOVINE COLLAGEN

1980's

Use: **Immobile or Poor Vibration**



PROS

Mechanical and Physiologic
Characteristics
(both etiologies)

Precise Administration

CONS

Short Acting(6mos)

Hypersensitivity
(skin test b4 injection)

Resorption
(overinject 20-30% more)

AUTOLOGOUS COLLAGEN

Use: Immobile and Poor Vibration



PROS

Mechanical and Physiologic
(comparable to bovine)

No Inflammatory Response

CONS

Short Acting (6mos)

Prohibitively Expensive
(5cm² skin → 1ml)

Resorption

Time Consuming
(3mos from harvest to
injection)

CADAVERIC COLLAGEN

(Cymetra, Alloderm)

Use: Immobile and Poor Vibration



PROS

Great Physiologic
Characteristics

No Inflammatory Response

Easy to Obtain

CONS

Short Acting (6mos-9mos, may
need boosters)

Resorption

AUTOLOGOUS FAT

Use: Immobile and/or Poor Vibration



PROS

Best Physiologic
Characteristics

No Inflammatory
Response

Abundant, uncomplicated
harvest

CONS

Unpredictable Duration
(approx 3mos)

Resorption

Longer Duration Need New Developments



- **Hydroxylapatite**

- mineral component of bone
- possible permanence of Teflon w/out immune response
- carrier gel absorbs quickly, no need for overinjection, no resorption

Two Years

- **Hyaluronic Acid**

- organic molecule
- viscoelasticity of vocal cord
- recruits fibroblasts w/out immune response, softens scars
- superior to bovine cartilage in maintaining vibratory characteristics

Two Years



Table 1
Comparison of materials for injection laryngoplasty

Material	Location of injection	Amount injected	Duration	Viscosity	Needle gauge	FDA Approval
Teflon	Lateral to vocal ligament	Exact amount	Permanent	Low	18	Yes
Bovine collagen	Lateral to vocal ligament or in vibratory membrane	Overinject	6 months	High	27	No
Human collagen	Lateral to vocal ligament or in vibratory membrane	Overinject	6 months	High	27–30	No
Cymetra	Lateral to vocal ligament	Overinject	6–9 months	Low	22	Yes
Fascia	Lateral to vocal ligament or in vibratory membrane	Overinject	3 months	High	18–22	NA
Fat	Lateral to vocal ligament or in vibratory membrane	Overinject	3 months	High	18–22	NA
Hydroxylapatite	Lateral to vocal ligament	Slightly overinject	2 years	Low	26	Yes
Hyaluronic acid	In vibratory membrane	Slightly overinject	2 years	High	26	No

O’Leary and Grillone 2006



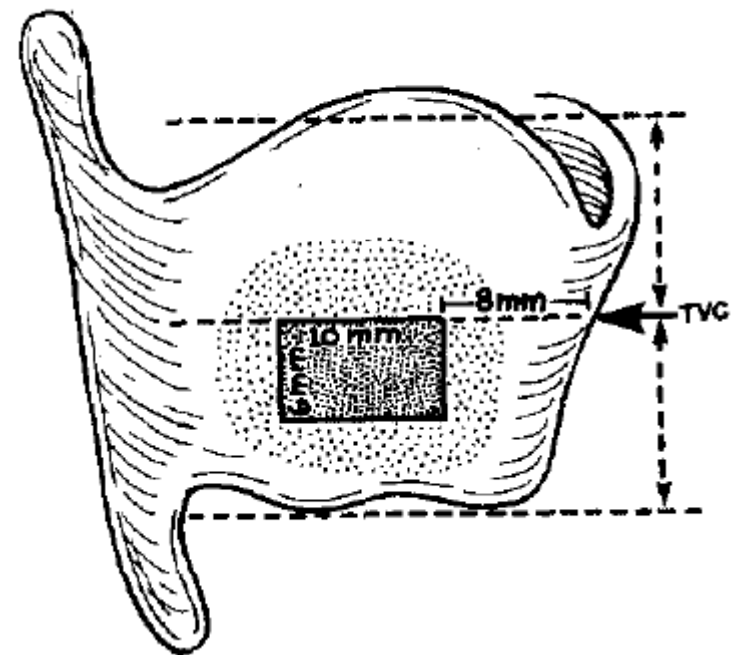
References

- Rubin and Sataloff “Vocal Fold Paresis and Paralysis” *Otolaryngol Clin N Am* 40 (2007) 1109-1131
- O’Leary, M. Grillone, G. “Injection Laryngoplasty” *Otolaryngol Clin N Am* 39 (2006) 43-54

Isshiki Type I Thyroplasty



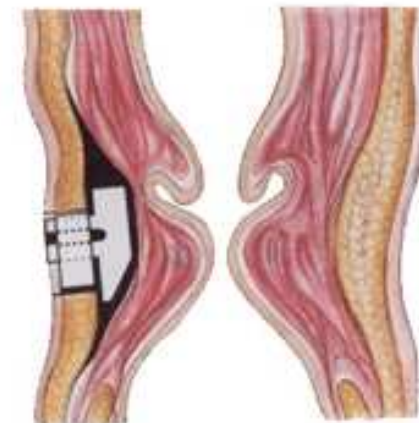
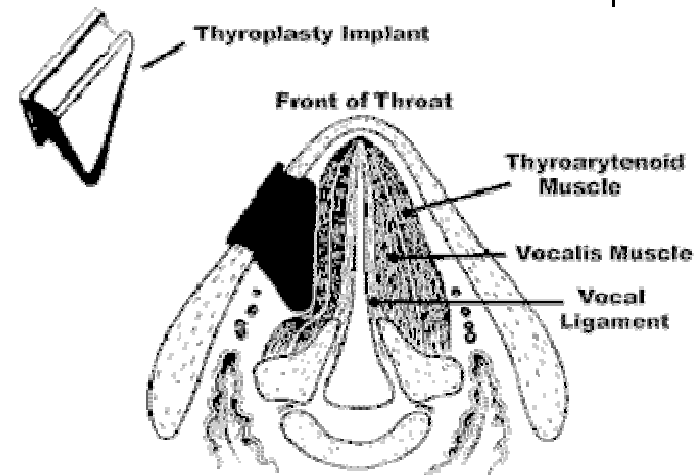
- Cervical incision to gain exposure of thyroid cartilage lamina
- Identify the true vocal line
- Design a window inferior to TVC about 5-10mm from anterior border ~5-6mm in height
- Remove cartilage window while preserving inner perichondrium



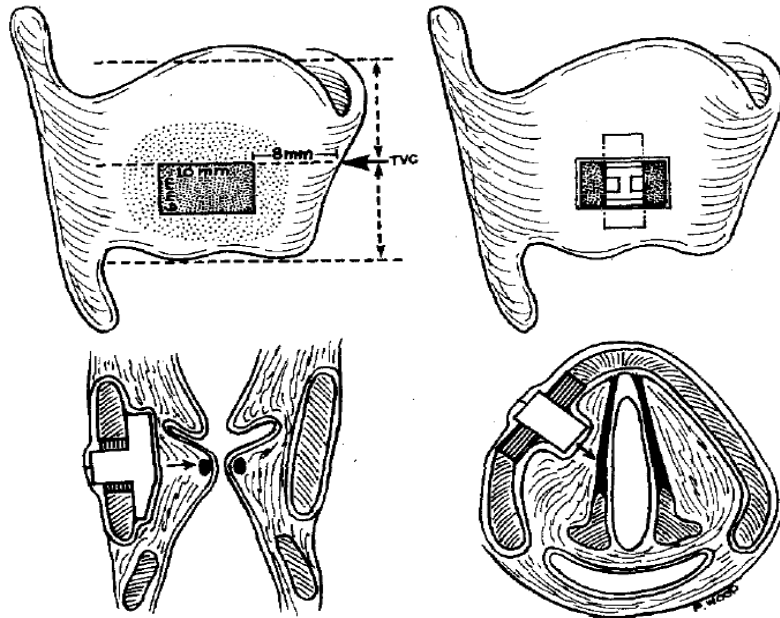
Choice of implant materials



- Silastic
 - Gore-Tex strip
 - Hydroxyapatite
 - Titanium
-
- Key to long term success is initial **OVERCORRECTION**



Commercially available thyroplasty implants



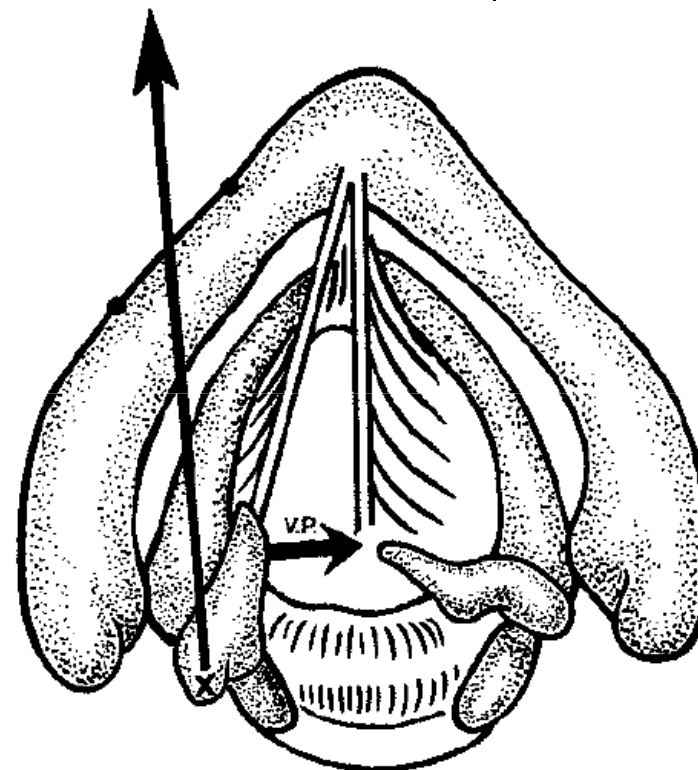
VoCom Thyroplasty system
(Hydroxyapatite)



Montgomery Thyroplasty system
(Silastic)

Arytenoid Adduction

- Requires more extensive dissection to expose muscular process of arytenoid
- Enables closure of posterior glottic chink
- Unable to correct bowing or cord atrophy
- Often used in conjunction with medialization thyroplasty



Results



	Thyroplasty I (n = 98)	Thyroplasty I With Arytenoid Adduction (n = 96)	Total (n = 194)
Mean vocal fold gap* (mm)			
Preop	1.6 (n = 93)	1.7 (n = 73)	1.6 (n = 166)
Postop	0.2 (n = 98)	0.1 (n = 96)	0.1 (n = 194)
Delta	1.4 (n = 93)	1.6 (n = 73)	1.5 (n = 166)
Symptom improvement			
Hoarseness	90	88	178
Aspiration	39	49	88
Dysphagia	34	43	77
Dyspnea	22	14	36
Overall	92 (94%)	89 (93%)	181 (93%)

Abraham et al. Laryngoscope 2001

Objective Results



Table 3 Mean parameters of phonetogram and MPT before and after medialization thyroplasty. *M* male; *F* female

Parameter		Mean (SD)		Difference		α
		Before	After	Absolute	%	
PR (smt.)	M	15.4 (7.0)	22.6 (7.9)	7.2	46.8	0.000*
	F	11.1 (5.5)	19.9 (3.8)	8.8	79.3	0.000*
IR (dB)	M	19.8 (5.6)	29.7 (8.0)	9.9	50.0	0.000*
	F	18.8 (5.1)	30.7 (6.2)	11.9	63.3	0.000*
S _{PG} (dB*smt.)	M	179.4 (133.8)	419.3 (223.0)	239.9	133.7	0.000*
	F	129.8 (88.2)	324.9 (122.6)	195.1	150.3	0.000*
MPT (s)	M	8.1 (6.6)	16.8 (11.1)	8.7	107.4	0.000*
	F	4.8 (4.1)	13.3 (4.0)	8.5	177.1	0.000*

*Statistically significant difference

Complications



TABLE VI.
Postoperative Complications.

	Thyroplasty I (n = 98)	Thyroplasty I With Arytenoid Adduction (n = 96)	Total (n = 194)
Transient edema	6	12	18
Hematoma/seroma	2	3	5
Infection	1	4	5
Extrusion	3	0	3
Airway	3	4	7
Tracheotomy	0	2	2
Overall*	14 (14%)	18 (19%)	32 (16%)

Abraham et al. Laryngoscope 2001



Conclusions

- Glottic incompetence results in disabling and possibly debilitating problems for the patient
- Injectable or surgical means of augmenting glottic closure can significantly improve glottic competence
- The choice of technique for vocal fold augmentation should depend on the severity of symptoms, the expected duration of glottic incompetence and patient factors



CASE STUDY: WL

- Hx of right true vocal cord paralysis and persistent hoarseness.
- Vocal cord paralysis onset: 7-8 years ago following a prolonged intubation secondary to medical complications from sepsis.
- Underwent a tracheostomy and PEG procedure while on the ventilator and attended intense rehabilitation.
- Decannulated/PEG removed w/in one year.



WL

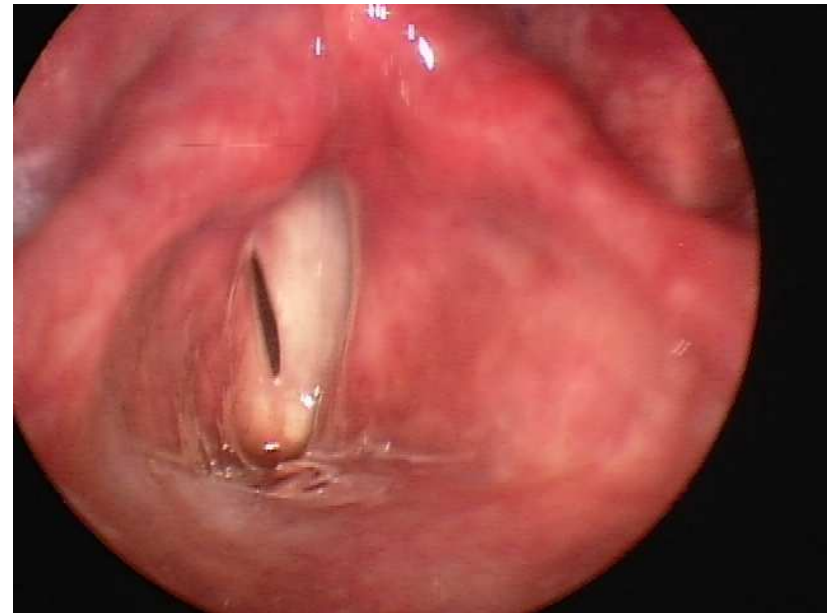
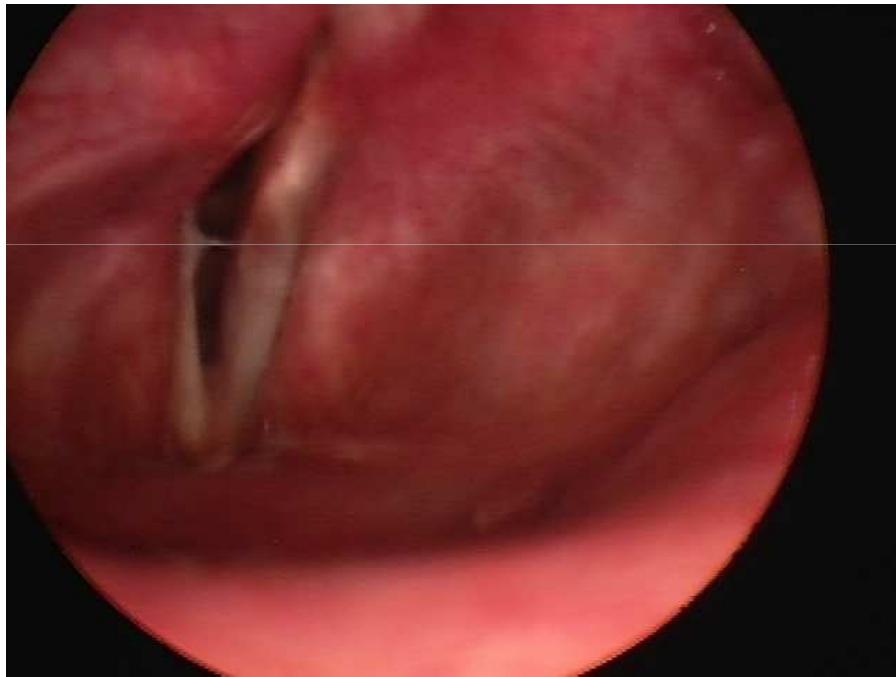
- No residual swallowing problems reported
- Hoarseness persisted due to Right vocal cord paralysis.
- A right sided laryngoplasty 2004 without significant vocal improvement.
- A Cymetra injection 6/07 with significant short-term vocal improvement. Due to the effects of the injection, patient underwent Radiesse injection in 8/08, but no change in hoarse voice quality was achieved.
- Patient no longer works due to his vocal hoarseness.

WL



- 1. No mass or ulcer
- 2. Right TVC immobile, erythematous, with rigid vibratory activity noted during phonation
- 3. Limited excursion of left true vocal cord noted; vibratory activity on the left WNL
- 4. Supraglottic erythema
- 5. Anterior-posterior compression noted during phonation indicative of hyperfunctional voice use, although this may be compensatory secondary to right TVC paralysis
- 6. Abnormal measures of perturbation with regard to frequency and amplitude; consistent vocal asthenia, strain and roughness

STROBOSCOPY



00:56:12 (6:1) - Fully adducted position, medial gap noted at modal pitch

WL



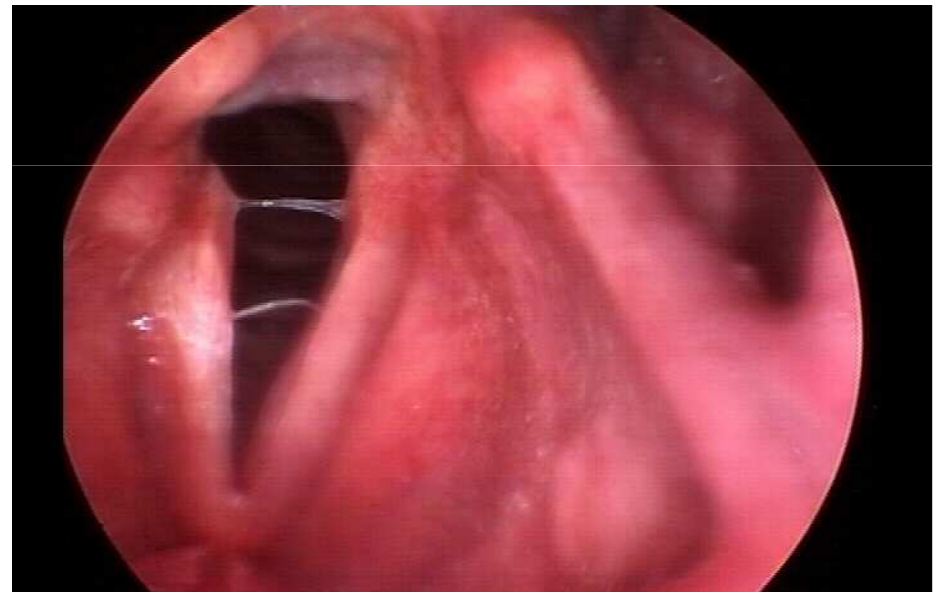
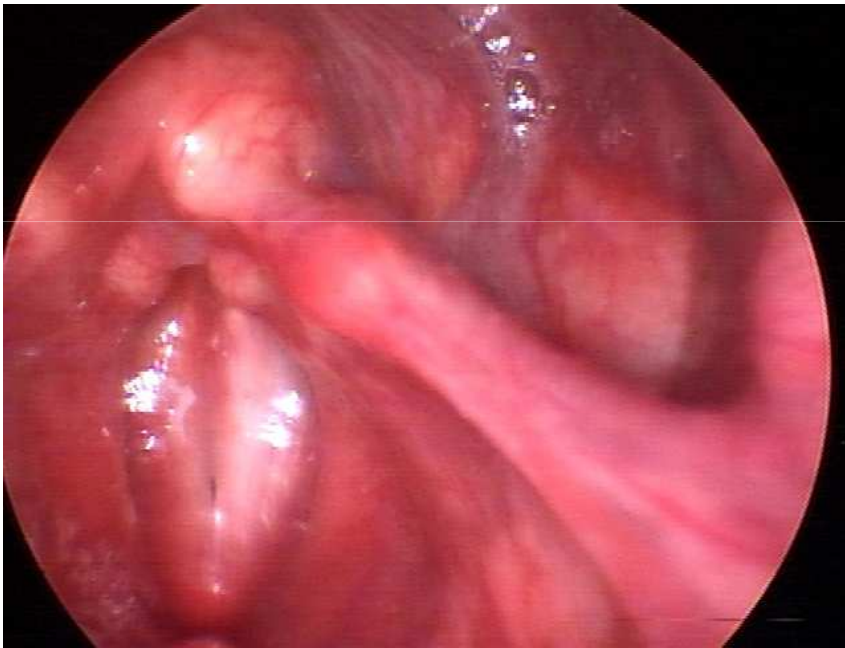
- RECOMMENDATIONS:
- 1. Continue GERD Rx and dietary and behavioral management of reflux
- 2. Voice therapy trial, 1x/week for 4-6 weeks, to maximize vocal strength and reduce hyperfunctional laryngeal behaviors.



CASE STUDY: JE

- JE is a 52 year-old male
- Right true vocal cord paralysis, idiopathic
- s/p bilateral medialization thyroplasty with right arytenoidpexy.

May 2006 JE



01

POSSIBLE BEGINNING SIGNS OF EXTRUSION OF IMPLANT

