



Adult Subglottic and Tracheal Stenosis

Karla O'Dell, MD
 Assistant Professor, Laryngology
 USC Voice Center
 Caruso Department of Otolaryngology, Head and Neck
 Co-Director USC Center for Airway Intervention and Reconstruction (AIR Center)

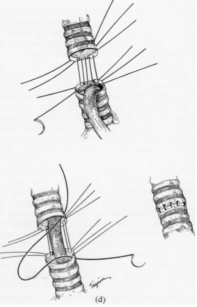







Thores (1973), 28, 667.

Reconstruction of the trachea Experience in 100 consecutive cases¹

HERMES C. GRILLO
 Massachusetts General Hospital, Boston, Massachusetts, USA







Grillo, H. C. (1973), *Thorax*, 28, 667-679. Reconstruction of the trachea. Experience in 100 consecutive cases. Anatomic mobilization of the trachea permits resection of one-half or more with primary anastomosis. An anterior approach by a cervical or cervicothoracic route utilizes cervical flexion to devolve the larynx and tracheal mobilization with preservation of the lateral blood supply. The transsternal route is employed for lower tracheal lesions. Over 100 tracheal resections have been done using these methods of direct reconstruction. Eighty-four patients suffered from benign strictures, 79 resulting from intubation injuries. Eleven primary tracheal tumours and five secondary tumours are included. The majority of lesions following intubation occurred at the level of the cuff. It was possible to repair 78 of the 84 stenotic lesions through a cervical or cervicothoracic approach. Seventy-three of the 84 patients with inflammatory lesions obtained an excellent or good functional and anatomic result. Nine of 11 patients with primary neoplasms who underwent reconstruction are alive and without known disease. There were five early postoperative deaths in these 100 consecutive patients who underwent tracheal reconstruction.










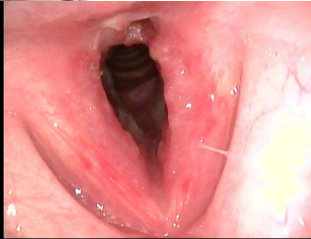
Causes of subglottic or tracheal stenosis




<p>Infectious</p> <ul style="list-style-type: none"> Tuberculosis Aspergillus Others <p>Systemic inflammation</p> <ul style="list-style-type: none"> Wegener's Granulomatosis Relapsing Polychondritis Sarcoidosis Amyloidosis Inflammatory Bowel Disease Others <p>Focal inflammation</p> <ul style="list-style-type: none"> Tracheostomy Intubation Trauma Burns Post-transplant Others 	<p>Dynamic collapse</p> <ul style="list-style-type: none"> Focal malacia Diffuse TBM* <p>Miscellaneous</p> <ul style="list-style-type: none"> Saber sheath trachea TBO** Broncholithiasis Idiopathic <p>Malignancy</p> <ul style="list-style-type: none"> Small cell lung cancer Non-small cell lung cancer Adenoid cystic carcinoma Metastatic disease
---	--
















Idiopathic Subglottic Stenosis



- "Idiopathic"
- Disease homogeneity
 - Female
 - Middle age
 - Caucasian
 - Stenosis subglottic and first ring
- Theories on cause –Estrogen, Inflammatory markers IL-17



The Laryngoscope
 Laryngology
Disease homogeneity and treatment heterogeneity in idiopathic subglottic stenosis
 Alexander Gelbard MD, Donald T. Donovan MD, Julina Ongkasuwan MD, S.A.R. Nouraei MD, PhD, Guri Sandhu MD, Michael S. Benninger MD, Paul C. Bryson MD, Robert R. Lorenz MD, MBA, William S. Tierney MS, Alexander T. Hillel MD, Shekhar K. Gadkaree BS, David G. Lott MD, Eric S. Edell MD, Dale C. Ekborn MD, Jan L. Kasperbauer MD, Fabien Maldonado MD, Joshua S. Schindler MD, Marshall E. Smith MD, James J. Daniero MD, MS, C. Gaelyn Garrett MD, James L. Nettlesville MD, Otis B. Rickman DO, Robert J. Sinaard MD, Christopher T. Wootten MD, David O. Francis MD, MS ... See fewer authors ^
 First published: 04 November 2015 | <https://doi.org/10.1002/lary.25708> | Citations: 29

USC Caruso Department of Otolaryngology Head and Neck Surgery
USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE

North American Airway Collaborative
 NoAAC
 the north american airway collaborative
 40 Publications
 9 Journals
 1214 Members
 The NoAAC is a regional voluntary consortium founded in 2014 to provide information about the management of adult airway disorders in North America and Europe.
 The North American Airway Collaborative exists to develop and exchange information concerning the treatment of adult airway disease. It is an international, voluntary, multi-disciplinary group of clinicians, and health care research personnel who seek to improve continuously the quality, safety, effectiveness, and cost of medical interventions in adult airway disorders.

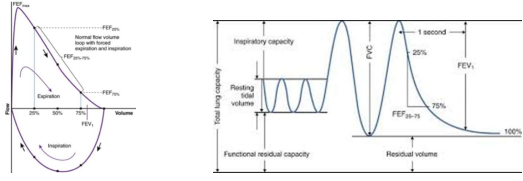
USC Caruso Department of Otolaryngology Head and Neck Surgery
USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE

In Office Bronchoscopy



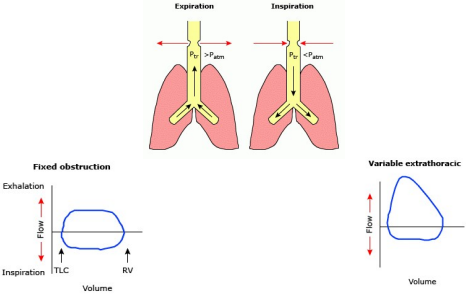
USC Tina and Rick Caruso Department of Otolaryngology Head and Neck Surgery
USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE

Pulmonary Function Tests



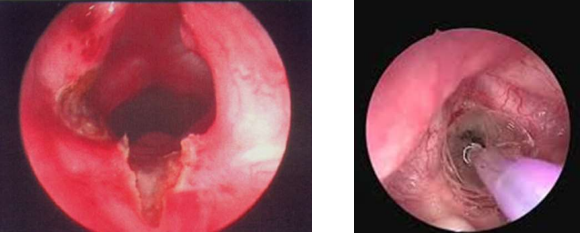
USC Caruso Department of Otolaryngology Head and Neck Surgery
USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE

Fixed obstruction vs **Variable extrathoracic**



USC Caruso Department of Otolaryngology Head and Neck Surgery
USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE

Initial Procedure- Endoscopic treatment



USC Caruso Department of Otolaryngology Head and Neck Surgery
USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE

USC- Post dilation protocol

- Qvar or steroid inhaler 1 month
- Bactrim 1 month
- Series of 3 subglottic Kenalog 40-80mg injected into scar spaced 1 month apart
- PFTs pre, post, after serial steroid, q 3 months
- Repeat series if begin to have symptoms or progressive change in PFTs

USC Caruso Department of Otolaryngology Head and Neck Surgery



USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE

Serial steroid injections

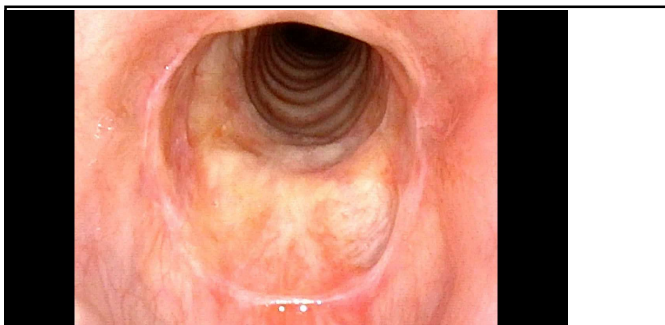
- First described by Ramon Franco in 2015, alternative treatment for iSGS



USC Caruso Department of Otolaryngology Head and Neck Surgery



USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE



USC Caruso Department of Otolaryngology Head and Neck Surgery



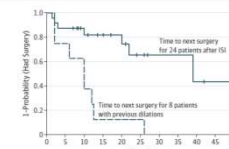
USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE

JAMA Otolaryngology-Head & Neck Surgery | Original Investigation

Serial In-Office Intralesional Steroid Injections in Airway Stenosis

Caitlin Bertelsen, MD, Hagit Shoffel-Havakuk, MD, Karla O'Dell, MD, Michael M. Johns III, MD, Lindsay S. Roder, MD

Figure 3. Kaplan-Meier Curve Showing Time to Surgery Pre-ISI and Post-ISI Series



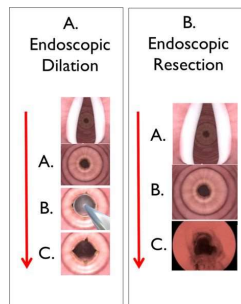
USC Caruso Department of Otolaryngology Head and Neck Surgery



USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE

Endoscopic Resection

Removing all tissue except thin mucosal bridges

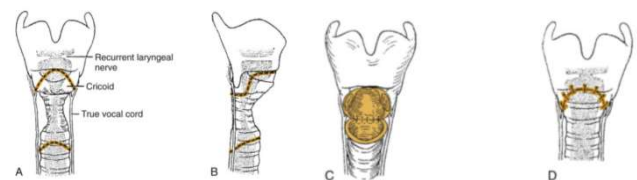


USC Caruso Department of Otolaryngology Head and Neck Surgery



USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE

Cricotracheal resection



USC Caruso Department of Otolaryngology Head and Neck Surgery



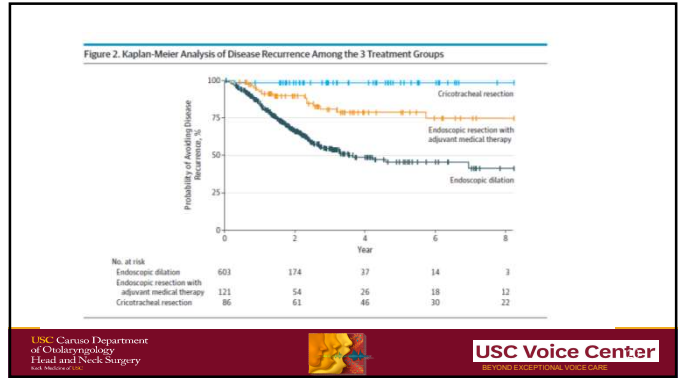
USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE

JAMA Otolaryngology-Head & Neck Surgery | Original Investigation

Comparative Treatment Outcomes for Patients With Idiopathic Subglottic Stenosis

Alexander Gelbard, MD, Catherine Anderson, BA, Lynne D. Berry, PhD, Milan R. Amin, MD, Michael S. Benninger, MD, Joel H. Blumin, MD, Jonathan M. Bock, MD, Paul C. Bryson, MD, Paul F. Castellanos, MD, Sheau-Chian Chen, PhD, Matthew S. Clary, MD, Seth M. Cohen, MD, Brianita K. Crawley, MD, Seth H. Dailey, MD, James J. Daniero, MD, MS, Alessandro de Alarcon, MD, MPH, Donald T. Donovan, MD, Eric S. Edell, MD, Dale C. Elsom, MD, Sasa Fernandez Taylor, PhD, Daniel S. Fink, MD, Ramon A. Francis, MD, C. Gwynn Garrett, MD, MMNC, Elizabeth A. Guardari, MD, Alexander T. Hillel, MD, Henry T. Hoffman, MD, Norman D. Hogikyan, MD, Rebecca J. Howell, MD, Li-Ching Huang, PhD, Lena K. Hussain, MS, Michael M. Johns III, MD, Jan L. Kasperbauer, MD, Sid M. Khosla, MD, Cheryl Kinnard, RN, Robbi A. Kupfer, MD, Alexander J. Langerman, MD, Robert J. Lentz, MD, Robert R. Lorenz, MD, David G. Lott, MD, Anne S. Lowery, BA, Sara S. Makani, MD, Fabien Maldonado, MD, Kyle Manning, MD, Laura Matkha, MD, Andrew J. McWhorter, MD, Albert L. Meatt, MD, Matthew C. Mori, MD, James L. Netterville, MD, Kara O'Dell, MD, Juliana Ongkasuwan, MD, Gregory N. Postma, MD, Lindsay S. Reeder, MD, Sarah L. Rhode, MD, Brent E. Richardson, MD, Otis B. Rickman, DO, Clark A. Rosen, MD, Michael J. Rutzer, MD, Guri S. Sandhu, MBBS, MD, Joshua S. Schindler, MD, G. Todd Schneider, MD, MS, Rupali N. Shah, MD, Andrew G. Sikora, MD, PhD, Robert J. Sinaur, MD, Marshall E. Smith, MD, Libby J. Smith, DO, Ahmed M. S. Solman, MD, Signður Svendsdóttir, MD, Douglas J. Van Daele, MD, David Weivers, MBBS, Sunil P. Verma, MD, Paul M. Weinberger, MD, Philip A. Weissbrod, MD, Christopher T. Wooten, MD, Yu Shyi, PhD, David O. Francis, MD, MS

USC Caruso Department of Otolaryngology Head and Neck Surgery
 USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE



© 2013 Karger Publishing Company. All rights reserved.

Subjective and Objective Parameters of the Adult Female Voice After Cricotracheal Resection and Dilation

Linda Bryans, MA; Andrew D. Palmer, MS; Joshua S. Schindler, MD; Peter E. Andersen, MD; James I. Cohen, MD, PhD

TABLE 1. ACOUSTIC VOICE CHARACTERISTICS AFTER CTR OR DILATION

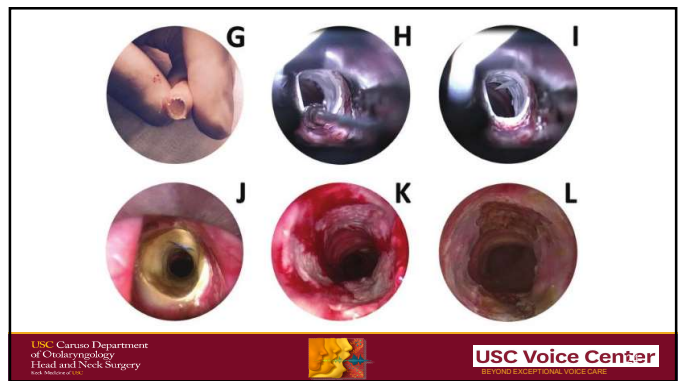
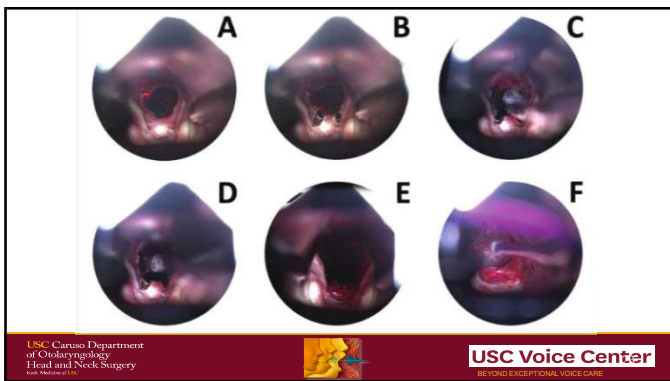
	CTR Group	Dilation Group	Z*	p
Maximum phonation time (s)	14.40 ± 7.19	16.35 ± 4.90	-0.92	0.36
Mean fundamental frequency /a/ (Hz)	188.13 ± 14.42	214.05 ± 29.95	-2.67	0.01†
Minimum fundamental frequency /a/ (Hz)	138.09 ± 22.59	140.44 ± 33.38	-0.07	0.94
Maximum fundamental frequency /a/ (Hz)	298.38 ± 48.06	533.37 ± 98.27	-3.70	<0.01†
Pitch range /a/ (semitones)	13.33 ± 2.56	23.30 ± 4.78	-3.62	<0.01†
Mean fundamental frequency reading (Hz)	172.45 ± 19.18	185.64 ± 21.21	-1.28	0.20
Minimum loudness /a/ (dB)	56.00 ± 4.58	58.50 ± 2.07	-2.37	0.02†
Maximum loudness /a/ (dB)	86.78 ± 5.81	94.25 ± 4.41	-2.51	<0.01†

Data are mean ± SD. CTR = cricotracheal resection.
 *From Mann-Whitney U test. †Significant at p ≤ 0.10 level.

USC Caruso Department of Otolaryngology Head and Neck Surgery
 USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE

Maddern procedure

USC Caruso Department of Otolaryngology Head and Neck Surgery
 USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE



Traumatic/Iatrogenic

- Intubation
 - Cuff pressure → Necrosis → Exposed cartilage → Circumferential scar → Stenosis
- Trach tube placement
 - Size of tube
 - Perc trach vs. open
 - High trach

USC Caruso Department of Otolaryngology Head and Neck Surgery



USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE

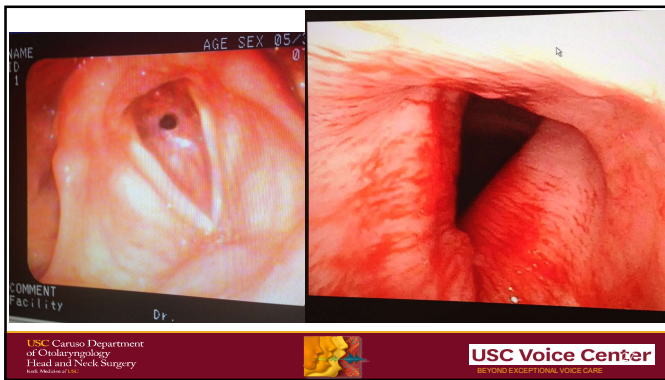
Cotton-Myer grade of stenosis

Classification	From	To
Grade I		
Grade II		
Grade III		
Grade IV	No Detectable Lumen	

USC Caruso Department of Otolaryngology Head and Neck Surgery



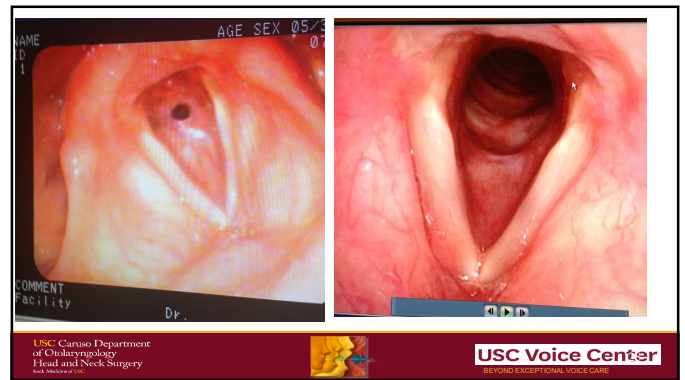
USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE



USC Caruso Department of Otolaryngology Head and Neck Surgery



USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE

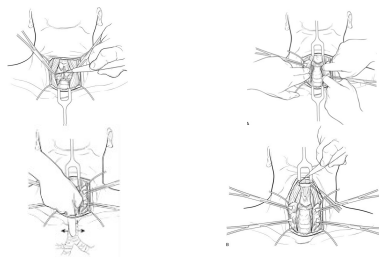


USC Caruso Department of Otolaryngology Head and Neck Surgery



USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE

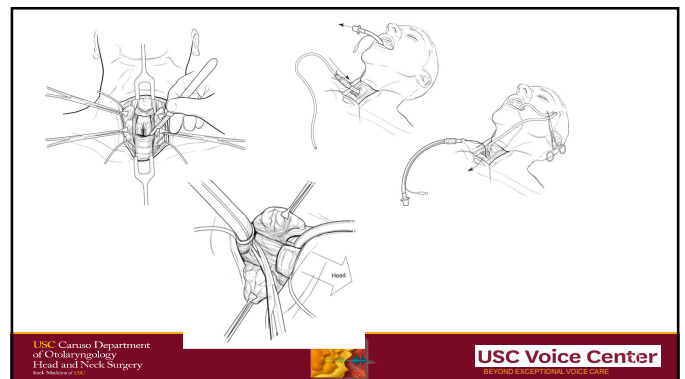
Tracheal resection/Cricotracheal resection



USC Caruso Department of Otolaryngology Head and Neck Surgery



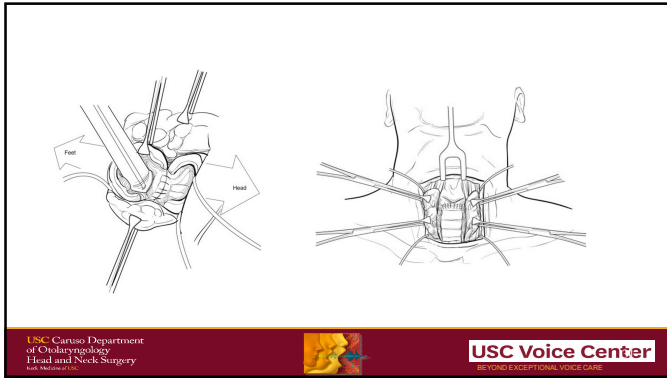
USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE



USC Caruso Department of Otolaryngology Head and Neck Surgery



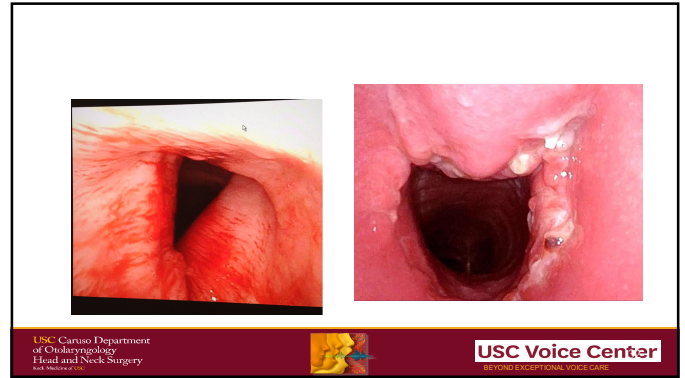
USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE



USC Caruso Department of Otolaryngology Head and Neck Surgery



USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE



USC Caruso Department of Otolaryngology Head and Neck Surgery



USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE

Tracheal Resection/CTR- USC

- In the last 5 years

Etiology	# of patients	% of total
Idiopathic	2	4.65%
Traumatic		
Intubation	2	5%
Tracheostomy	31	72%
Autoimmune/Inflammatory	0	0%
Cancer	8	19%
Total patients	43	

USC Caruso Department of Otolaryngology Head and Neck Surgery



USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE

Complex cases

- Multi-level stenosis
- Low stenosis
- Requires team approach

USC Caruso Department of Otolaryngology Head and Neck Surgery



USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE

[About](#)
[Our Team](#)
[Treatments & Services](#)
[Patient Information](#)
[Medical Professionals](#)
[Contact Us](#)

Relief for breathing problems

Our team of expert otolaryngologists, thoracic surgeons and interventional pulmonologists can help alleviate symptoms caused by narrowing of the airway passages.

USC Airway Intervention & Reconstruction Center (USC Air Center)

Our Program

[Find a Provider](#)
[Request an Appointment](#)
[Request an appointment](#)

(800) USC-CARE

USC Caruso Department of Otolaryngology Head and Neck Surgery



USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE

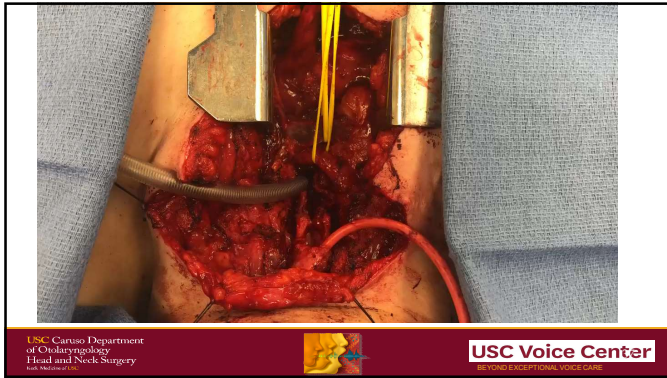
Complex cases

- Multi-level stenosis- Glottic and tracheal
 - Manage the glottic stenosis first
- Low stenosis- Thoracic for mini sternotomy

USC Caruso Department of Otolaryngology Head and Neck Surgery



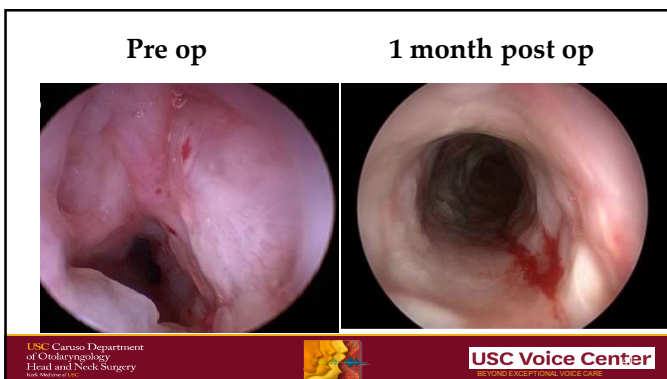
USC Voice Center
BEYOND EXCEPTIONAL VOICE CARE



Composite Grafting

- Radial forearm free flap with buried auricular cartilage
- Rarely used
- Option after failed resection

USC Caruso Department of Otolaryngology Head and Neck Surgery
 USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE





 Biochemical and Biophysical Research Communications
 Volume 510, Issue 2, 5 March 2019, Pages 205-210

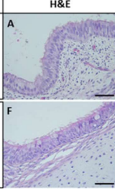
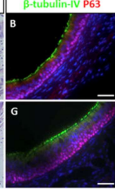
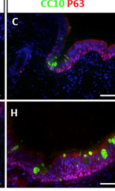
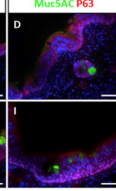
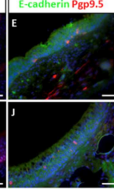
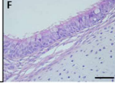
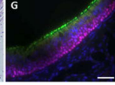
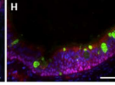
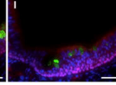
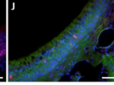
Differential epithelial growth in tissue-engineered larynx and trachea generated from postnatal and fetal progenitor cells

Hanaa Knaneh-Moneem ¹, Matthew E. Thornton ¹, Brendan H. Grubbs ¹, David Warburton ¹, Tracy C. Grikscheit ^{1,2}, Christian Hochstim ^{1,2,3}


[Show more](#)

USC Caruso Department of Otolaryngology Head and Neck Surgery


USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE


	H&E	β -tubulin-IV P63	CC10 P63	Muc5AC P63	E-cadherin Pgp9.5
Native trachea					
TE trachea					

USC Caruso Department of Otolaryngology Head and Neck Surgery


USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE

Any questions?

USC Caruso Department of Otolaryngology Head and Neck Surgery


USC Voice Center
 BEYOND EXCEPTIONAL VOICE CARE