Open reconstruction of Airway Stenosis
Laryngotracheal Stenosis

- Etiology
  - External trauma (MVA, surf board, assault, etc.)
  - Internal trauma (Endotracheal intubation, tracheostomy)
  - Other
    - Systemic diseases (vasculitis, etc.)
    - Chemo/XRT
    - Idiopathic
Laryngotracheal stenosis

Diagram labels:
- Vocal cords
- Cricoid cartilage
- Stomal stenosis
- Cuff injury
- Tube tip granulation

Source: LAHEY CLINIC © 1980
Laryngotracheal stenosis
New Technology

- Trans-nasal “Esophagoscope”
- Expanded diagnostic endoscopy
  - Laryngoscopy
  - Bronchoscopy
  - Esophagoscopy

- 2.0 mm Working Channel
  - Biopsies
  - Injections
  - Procedures
Not all stenosis need to be treated!
Tracheal Anatomy

- 10-12 cm in length (adult)
- 13-16 mm width (females) and 16-20 mm width (males)
- 16-20 horseshoe shaped cartilage
- Membranous: cartilaginous trachea::1:4.5
Blood supply
- Cervical trachea supplied by superior and inferior thyroid arteries
- Mediastinal trachea supplied by bronchial arteries
- Extensive dissection around trachea causes ischemia
Tracheal stenosis

- 2-3 cm (4-6 rings) may be resected and reanastomosed primarily
- Tracheal resection maneuvers allow resection of more rings
  - Suprahyoid release
  - Infrahyoid release
  - Intrathoracic tracheal mobilization
Laryngeal release

- Suprahyoid release (Montgomery)
  - Muscle attachments to the superior aspect of hyoid bone are severed and central hyoid cut
  - Larynx and cervical trachea allowed to drop inferiorly
  - Can give up to 2-3 cm in length
  - Significant post-op dysphagia a possible major complication compared to infrahyoid release
Laryngeal release

- Infrahyoid release (Dedo)
  - Inferior attachments to the hyoid are severed
  - Especially the thyrohyoid muscle and thyrohyoid membrane
  - Can add up to 2.5 cm length
Tracheal resection

- Grillo 1964 (Intrathoracic maneuvers)
  - Division of pulmonary ligament $\rightarrow$ 3 cm (5.9 rings)
  - Division of mainstem bronchus $\rightarrow$ 2.7 cm (5.5 rings)
  - Pericardial dissection $\rightarrow$ 0.9 cm (1.6 rings)
- Up to 6.4 cm trachea (about 13 rings) can be excised with the help of release maneuvers
Tracheal resection
Tracheal resection
Tracheal resection

Fig. 4

Fig. 5

Fig. 6
Tracheal resection
Subglottic stenosis
Cricotracheal resection

THYROID
CRICOID
TRACHEA
RECURRENT LARYNGEAL NERVE
Cricotracheal resection

Pearson
Cricotracheal resection

- Cricoid
- Membranous wall
- Thyroid

[Image showing anatomical structures related to cricotracheal resection]
Cricotracheal Resection

PRE-CTR

POST-CTR
**Long segment laryngotracheal stenosis**

- **Common scenarios**
  - 2-level stenosis (glottic + subglottic, subglottic + tracheal, stenosis + tracheostomy tube)
  - Typically involvement of the stenosis is 3 cm or more
- **What are the options?**
  - Reconstruct without removal of scar
  - Reconstruct with removal of scar
Treatment of Laryngotracheal Stenosis

- **Endoscopic**
  - Laser
  - Dilation
  - ± Steroid injection, Mitomycin-C application

- **Open Surgical**
  - Primary resection and anastomosis
  - Laryngotracheoplasty (LTP)
    - Grafts (cartilage, mucosa)
    - Stenting
    - Single stage versus multistage
LTP: No scar removed
LTP: With scar removal

- Staged Laryngotracheoplasty
  - Resect scar and make an “open trough”
  - Line scar with mucosa (buccal)
  - Close trough in 2-3 weeks
  - Place T-tube stent
Laryngotracheoplasty – Stage 1

Diagram showing the surgical approach and anatomical structures involved in stage 1 of laryngotracheoplasty.
Laryngotracheoplasty – Stage 1

- Approach
- Skin
- Platysma
- Scar
- Buccal Graft
- Coe-Soft Stent
Stage I LTP
Laryngotracheoplasty – Stage 2

Mesh

Buccal Graft

T-tube Stent
Laryngotracheoeploplasty – Stage 2
Stage II LTP
Laryngotraceopectomy – Stage 3

LTP Stage 3 – Without T-Tube

LTP Stage 3 – With T-tube
Staged LTP

- Remove stent in 6-months
- Replace with trach tube
- If no recurrence of stenosis then decannulate 2-3 weeks later
Staged LTP

- Staged Expansion Laryngotracheoplasty
  - Stage I (laryngotracheofissure, resection of stricture endoluminally, application of buccal mucosal graft, placement of prosthetic endoluminal bolster, open upper airway trough)
  - Stage II (placement of lateral marlex mesh)
  - Stage III (closure of anterior neotracheal wall incorporating mesh, advancement skin flaps)
Staged LTP

Trough

Marlex Mesh
Laryngotracheal Stents

- **Purpose of stents**
  - Stabilize the larynx or trachea after surgery to **prevent collapse** of the lumen
  - **Counteract or prevent** recurrent scar formation

- **Stent Trivia**
  - The word stent is derived from Charles B. Stent, a British dentist who practiced in the late 19th century
Types of Stents

- Laryngeal
  - Aboulker stents, silicone stents, Montgomery laryngeal stents, endotracheal tubes, and laryngeal keels
**Types of Stents - Tracheal**

**SILICONE TRACHEAL STENT**
- Long-term tolerability
- Easily removable.
- Poor mucociliary clearance
- Can migrate

**METALLIC TRACHEAL STENT**
- Incorporates into mucosa
- Difficult to remove
- Better mucociliary clearance
- More reaction and granulation tissue
T-Tube
Insertion of a T-tube
Insertion of a T-tube

Fig. 2. Technique to customize the T-tube by marking the suction corresponding to the level of the tracheostomy, stenosis, and true vocal cords.
Insertion of a T-tube
Insertion of a T-tube
Insertion of a T-tube

Fig. 5. Proper placement of the T-tube through the stoma, across the stenosis. The looped suture is then cut and removed.
Removal of a T-tube

- Curved hemostats
- Know which limb is shorter
  - Take this side out first
- Grasp as low as possible
- Pull it out like a banana
Case Presentations #1

- Principles
  - **Subglottic/tracheal stenosis** –
  - No trach, not-intubatable
    - LMA
    - Endoscopic Balloon Dilation with CRE catheter system
    - CTR vs. staged LTP if serial dilations not sufficient or desired
    - Or CTR vs LTP, trach through stenosis under visualization
Case Presentations #2

- **Principles**
  - **Subglottic lesion, tracheostomy present**
    - Assess location of tracheotomy and distance from stenosis
    - Then perform CTR versus staged LTP
    - Need repeated procedures
Principles

- **Tracheal Stenosis – soft web**
  - Do LMA (allows one to visualize stenosis endoscopically), balloon dilation
    - If severe, Do LMA, then trach, then assess lesion
  - **If severe tracheal lesion then do trach through stenosis**
    - Primary resection with anastomosis
    - Tracheoplasty (staged)
  - For **severe stenosis** best to perform awake trach, then as above