AUGUST 15, 2012 LARYNGOTRACHEAL STENOSIS

E.N.T. HEAD AND NECK DEPT
UBTH

15-08-2012

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OUTLINE

- INTRODUCTION
- CASE PRESENTATIONS
- RELEVANT ANATOMY
- EPIDEMIOLOGY
- AETIOLOGY
- PATHOGENESIS
- MANAGEMENT-HX
  - -EXAMINATION
  - -INVESTIGATIONS
  - -DIFFERENTIAL DIAGNOSIS
  - -RX /COMPLICATIONS
  - -PREVENTION
  - -RECENT ADVANCES
  - -LOCAL EXPERIENCE
- CONCLUSION

INTRODUCTION

- It is abnormal narrowing of the central air passages of the larynx and trachea. It may be in a single location or at multiple locations along the laryngotracheal airway.
- The causes are varied and it could be life threatening prompt diagnosis and treatment is necessary.

CASE 1

- A.M
- 29YRS
- Female
- Esan
- Christian
- Teacher
- Textile mill rd

Presented 4 years ago

Via referral from O and G team.

C/O--difficulty in breathing X 4/52

Was on mechanical ventilation via endotracheal intubation x 6weeks in ICU here in UBTH for intrapartum eclampsia.

Nil other throat complains

Nil history of previous head or neck trauma or surgery

- ENT examination then revealed
- RR- 48CPM
- ICR ,SCR biphasic stridor, tracheal tugging.
- BS- decreased with rhonchi in both lung fields.

- X ray soft tissue neck revealed narrowing of the air way at the level of c5-c6.
- A diagnosis of subglottic stenosis secondary to prolonged intubation was made.

- Tracheostomy and D/L was done.
- D/L done revealed subglottic stenosis with a little opening.
- She further had dilatation and laryngotracheal stenting
- She was subsequently decannulated ,observed and discharged home.

- She however represented 2weeks later in airway obstruction.
- She had repeat tracheostomy and direct laryngoscopy
- Findings – Posterior Laryngeal Web
- was billed for micro laryngoscopy and clearance
- She however became pregnant and this delayed treatment.
- She represented 8 weeks ago , 6months after delivery for clearance.
- Finding at op were web in the posterior aspect of the laryngeal inlet with resultant reduced laryngeal inlet.

- Web was cleared.
- Observed for 48 hrs
- Decannulated , thereafter, discharged
- She represented 24hrs later in airway obstruction.
- Had reinsertion of t.tube and flexible laryngoscopy
- FBL revealed freely mobile VC and subglottic stenosis.
- She was adequately counselled is being worked up for laryngofissure and stenting.

CASE 2

- A.E
- 24YRS
- Male
- Isoko
- Christian
- Wood worker
- Ugbogui village

- C/O- Difficulty in breathing x 24hrs
- Progressively worsening assoc with noisy breathing.
- Positive history of aphasia
- Nil other throat symptoms
- Nil nose and ear symptoms

- He was previously managed by the neurosurgeons for head injury.
- Sustained via an industrial accident

- He was unconscious and was intubated for 17days.
- Intubation was in A/E and he had several extubations one on account of a blocked tube, once he extubated himself.

- O/E by the ENTTOC in A/E
- He was acutely ill looking afebrile not pale anicteric with oral endotracheal tube insitu.
- CVS ; PR-112BPM
- BP -120/70MMHG
- HS S1 S2

- Chest –
- RR- 28CPM
- BS-vesicular with wide spread transmitted sounds.
- CNS- GCS-9/15
- Left facial nerve palsy

- Eyes; bilateral periorbital ecchymosis.
- bilateral chemosis worse on left
- good RE opening
- with right pupil reactive to light
- inability to open left eye spontaneously
- left pupil dilated and unresponsive to light

- Ears – nil abnormalities
- Nose – nil abnormalities
- Oral cavity/oropharynx- nil abnormalities

- Fiberoptic laryngoscopy – freely mobile vocal cords good glottic opening with a subglottic web posteriorly located.
- X-ray soft tissue neck revealed a soft tissue shadow at the level of the subglottis.

- A diagnosis of subglottic stenosis secondary to prolonged intubation was made.
- He had tracheostomy done and was admitted into the ward.

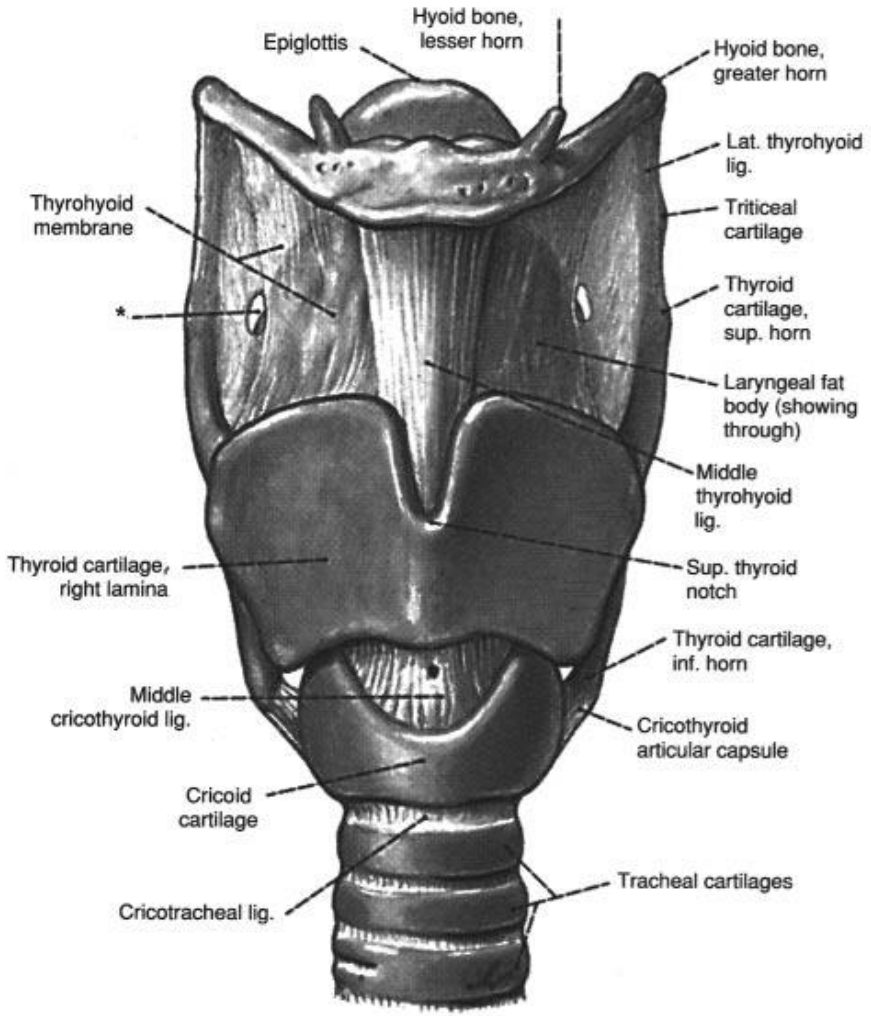
- However while in the wards worsening left eye chemosis was noticed and ophthalmology team reviewed.

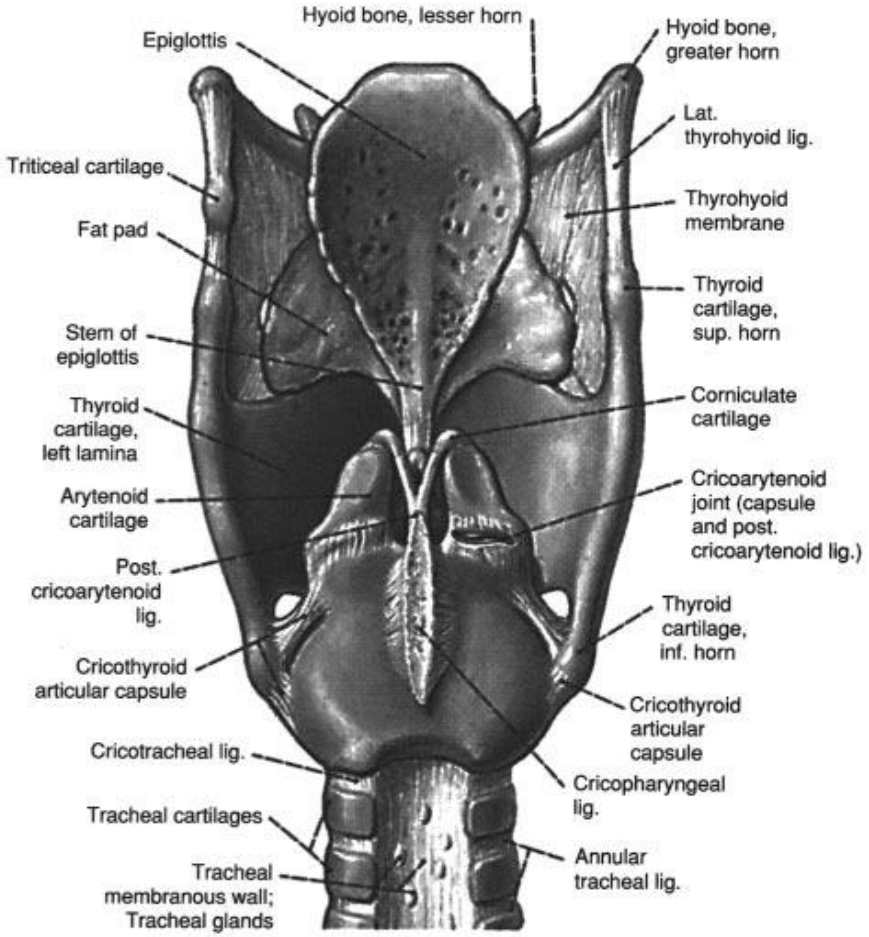
- A diagnosis of carotico carvenous fistula was made he was placed on topical antibiotics and left eye padding.

- He has being discharged and is being worked up for a microlaryngoscopy and stenting.

RELEVANT ANATOMY

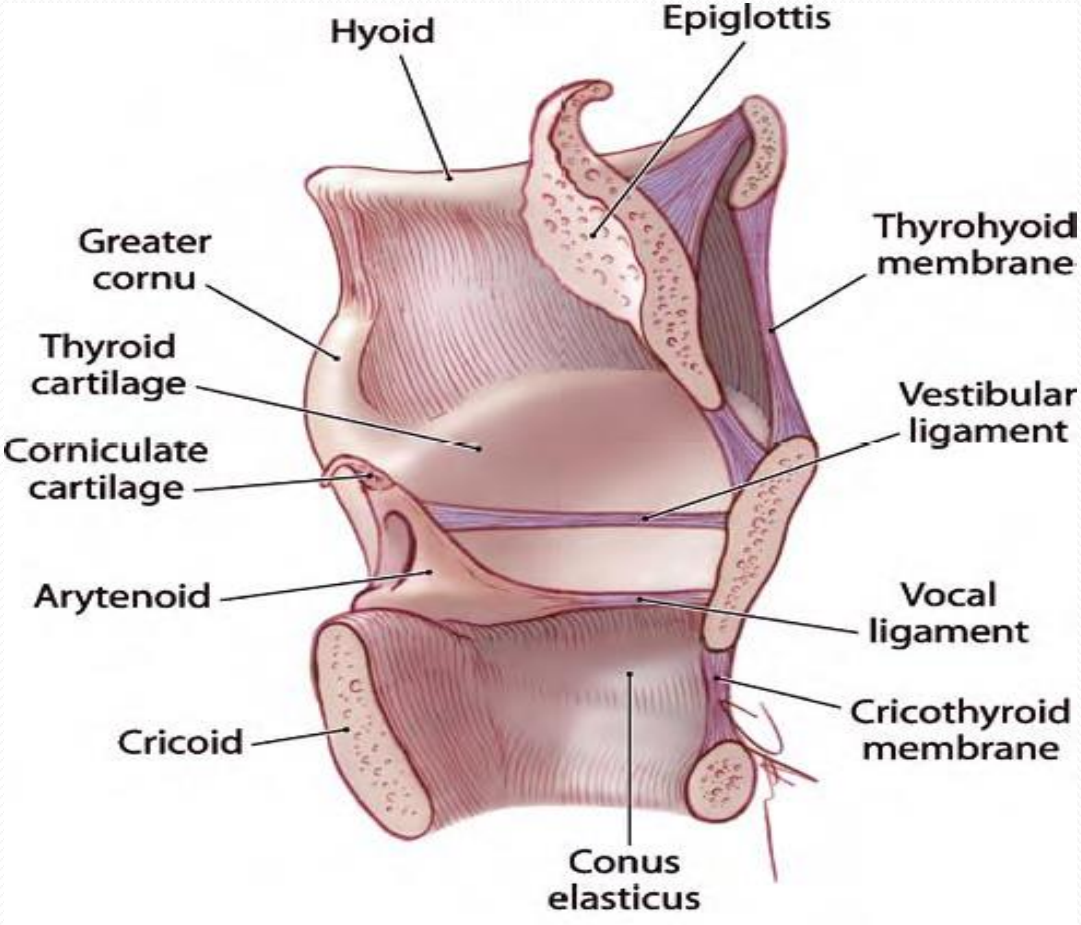
- The larynx is the upper end of the lower respiratory tract.
- It is averagely 44mm long and 36mm wide and in the midline opposite c3-c6 vertebrae.
- It is made up of cartilages connected by ligaments and membranes lined by mucus membranes and moved by muscles.


Epiglottis
Hyoid bone, lesser horn
Hyoid bone, greater horn
Lat. thyrohyoid lig.
Thyrohyoid membrane
Triticeal cartilage
*
Thyroid cartilage, sup. horn
Laryngeal fat body (showing through)
Middle thyrohyoid lig.
Thyroid cartilage, right lamina
Sup. thyroid notch
Thyroid cartilage, inf. horn
Middle cricothyroid lig.
Cricothyroid articular capsule
Cricoid cartilage
Tracheal cartilages
Cricotracheal lig.


Epiglottis
Hyoid bone, lesser horn
Hyoid bone, greater horn
Lat. thyrohyoid lig.
Triticeal cartilage
Thyrohyoid membrane
Fat pad
Thyroid cartilage, sup. horn
Stem of epiglottis
Corniculate cartilage
Thyroid cartilage, left lamina
Cricoarytenoid joint (capsule and post. cricoarytenoid lig.)
Arytenoid cartilage
Post. cricoarytenoid lig.
Thyroid cartilage, inf. horn
Cricothyroid articular capsule
Cricothyroid articular capsule
Cricotracheal lig.
Cricopharyngeal lig.
Tracheal cartilages
Annular tracheal lig.
Tracheal membranous wall; Tracheal glands

Laryngeal cartilages

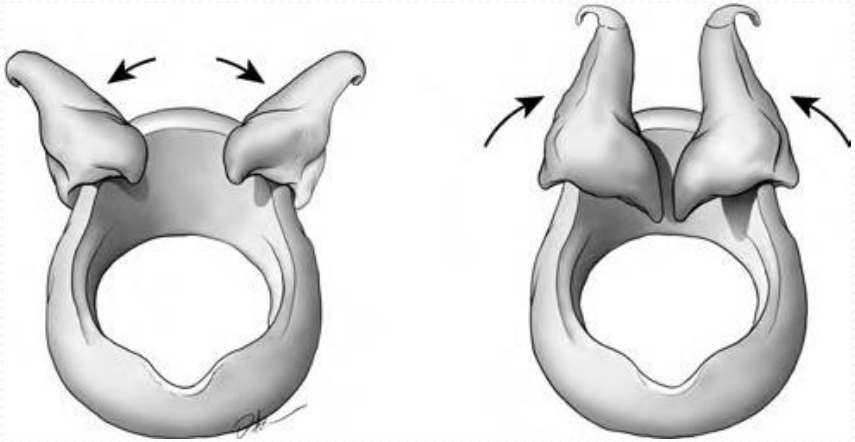
- Paired
  - Arytenoid
  - Corniculate (Santorini)
  - Cuneiform (Wrisberg)
- Unpaired
  - Epiglottis
  - Thyroid
  - Cricoid



Joints of larynx

- Cricothyroid joint

- **Crico-arytenoid joint**



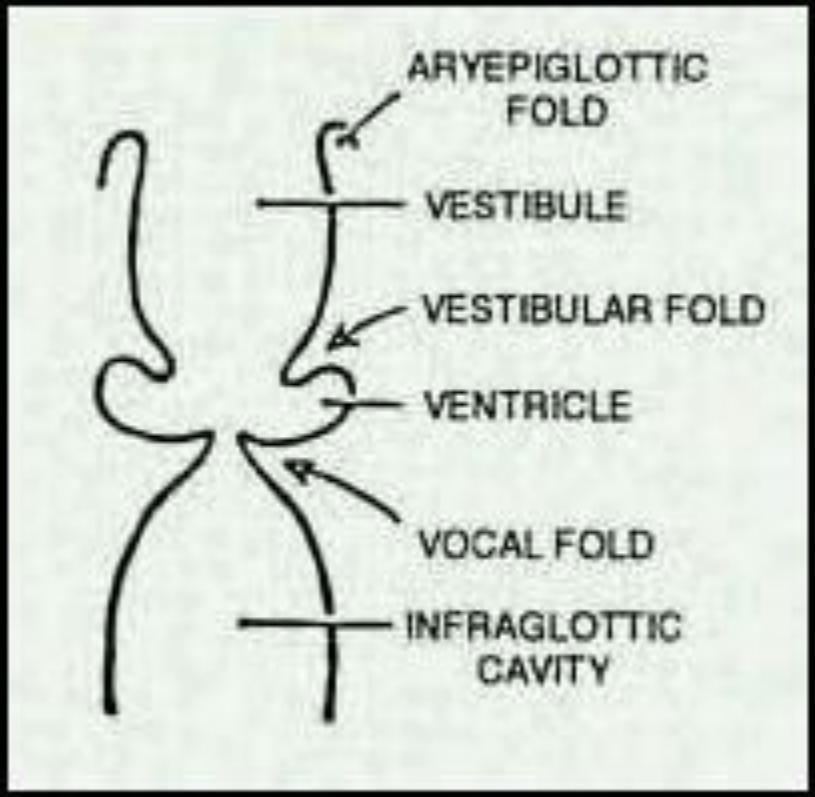
Rotation and gliding

CAVITY OF THE LARYNX

- Starts at the laryngeal inlet where it communicates with the pharynx.
- And ends at the lower border of the cricoid cartilage where it is continues with the lumen of the trachea.

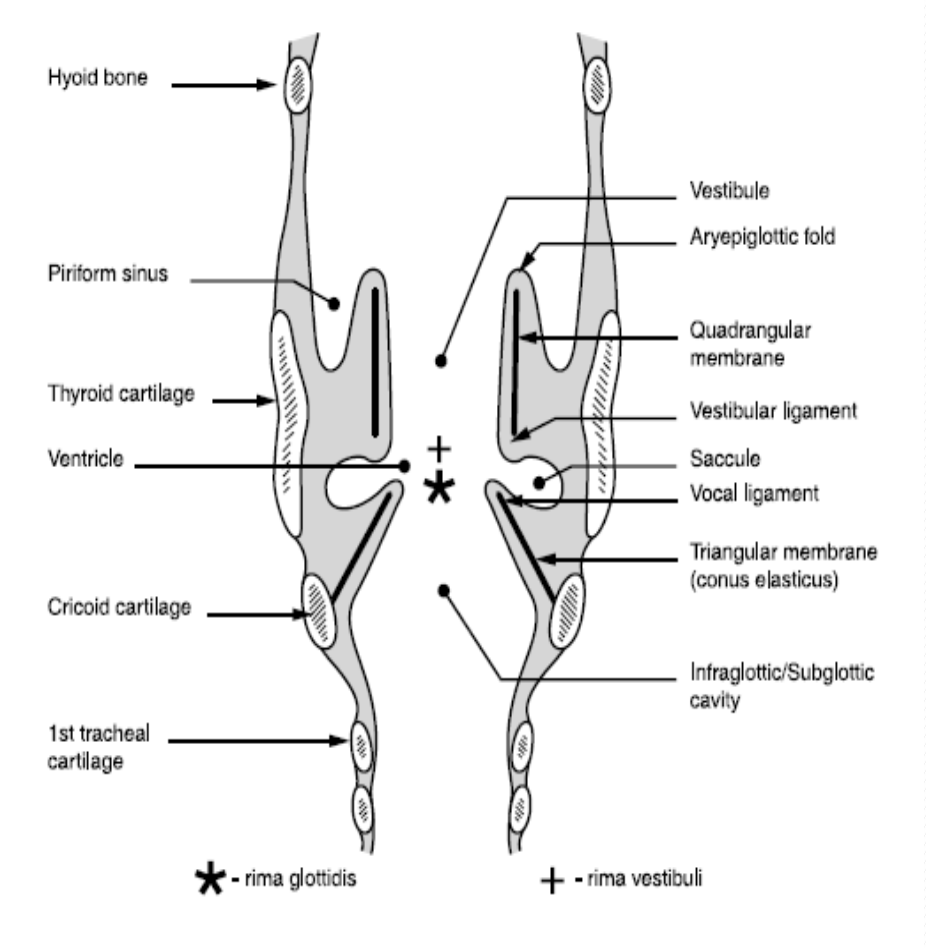
CAVITY OF THE LARYNX

- 2 pairs of folds vestibular and vocal divide the cavity into 3 parts.
- which are the vestibule, ventricle and subglottic space.


ARYEPIGLOTTIC FOLD
VESTIBULE
VESTIBULAR FOLD
VENTRICLE
VOCAL FOLD
INFRAGLOTTIC CAVITY

Laryngeal cavity

- Supraglottic
  - Vestibule
  - Ventricule
- Glottic
  - 2.5cm male
  - 1.6cm female
- Infraglottic /subglottic



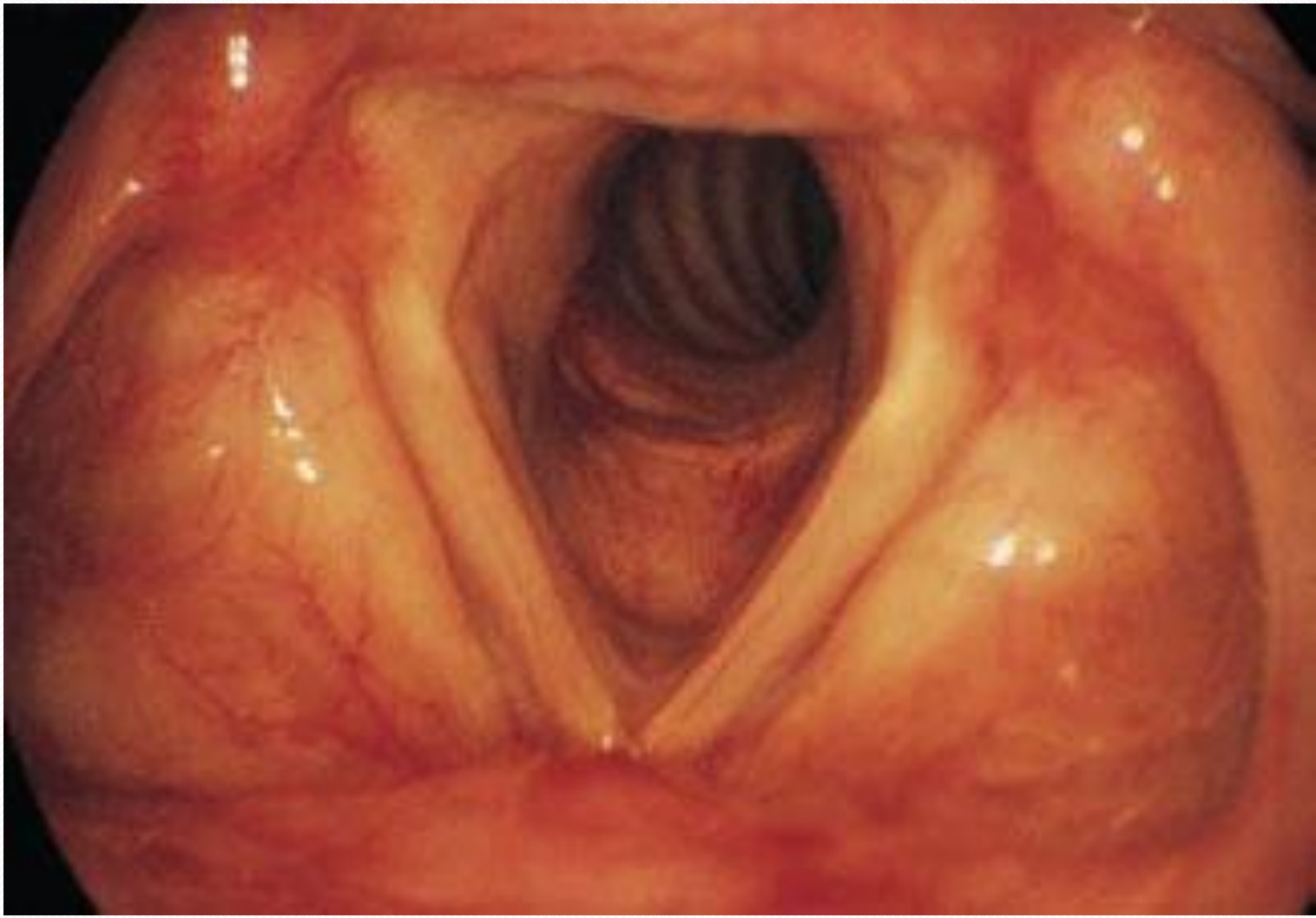
Functions of the larynx

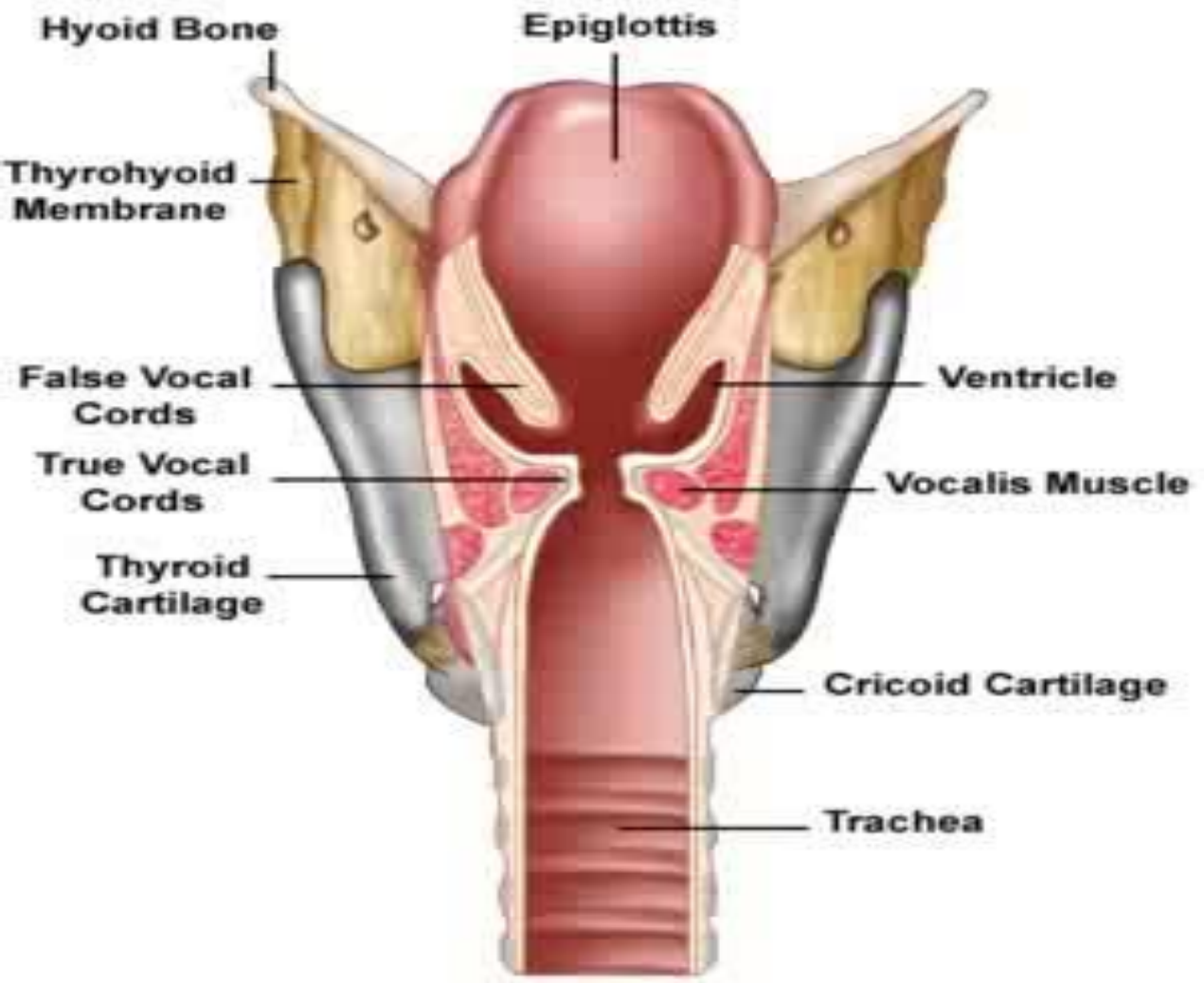
Biological

- Respiration
- Protection of the lower airway
- Fixation of the chest

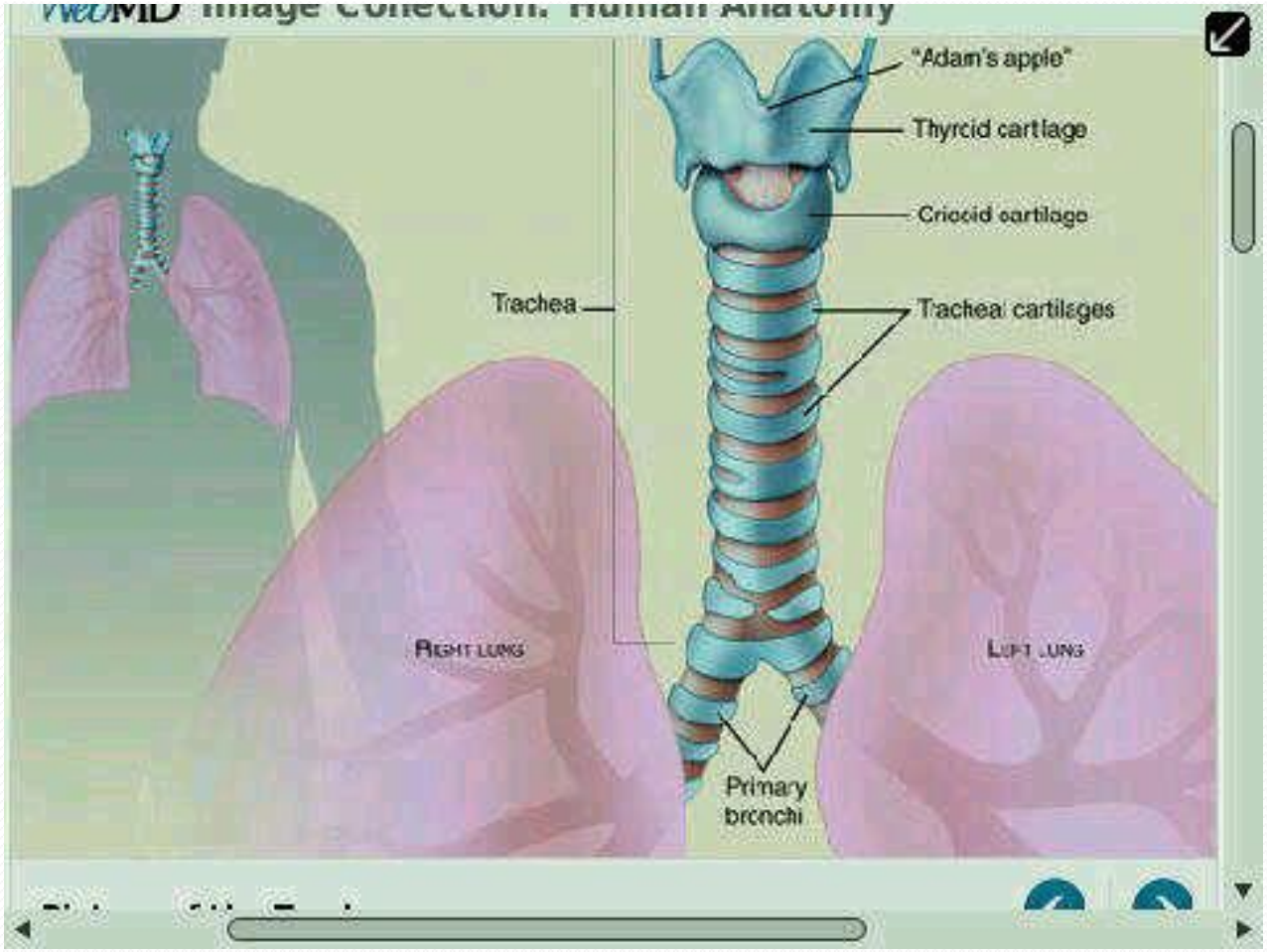
Non biological

- Phonation.




Hyoid Bone
Epiglottis
Thyrohyoid Membrane
False Vocal Cords
Ventricle
True Vocal Cords
Vocalis Muscle
Thyroid Cartilage
Cricoid Cartilage
Trachea

- It continues with the trachea.
- the trachea is 11.5 cm in length and 2.5cm wide.
- Terminates at t4/t5 by bifurcating.
- held patent by 15- 20 C-shaped cartilages deficient posteriorly and completed by fibrous tissue and trachealis muscle.


"Adam's apple"
Thyrcid cartlage
Criocid cartlage
Trachea
Tracheal cartilages
Primary bronchi

Functions of the trachea

- Connects the central air passage of the larynx to the lungs.
- It is lined with cells that produce mucus which traps particles to clean before it reaches the lungs.
- It is the pathway of air pressure from the lungs to the larynx for phonation.
- Its flexible and collapses slightly to allow food bolus go down oesophagus.

EPIDEMIOLOGY

- Children
- Adult

-- Laryngeal trauma – M>F 3:1

AETIOLOGY

- Acquired and congenital
- External laryngotracheal trauma:-
  - Penetrating tissue injury
  - Blunt force neck trauma; high or low velocity impact
- Internal laryngotracheal trauma:-
  - Endotracheal intubation
  - Post tracheostomy

cont'd

- - Post microlaryngoscopy and resection
  - Post radiotherapy
  - Endotracheal burns:chemical, thermal
- Infection:-
  - Tuberculosis
  - Scleroma
  - Fungal histoplasmosis
- Chronic inflammatory disease:
  - sarcoidosis

Cont'd

- Collagen vascular disease:-
  - Wegner's granulomatosis
  - Relapsing polychondritis
- Prematurity (Birth weight less than 1500g)
- GERD

PATHOGENESIS

- INTUBATION:- Mechanical trauma of placement or its contact pressure. Mucosal edema and hyperaemia-→ mucosal necrosis→ perichondrium exposure→ infection of perichondrium→ subglottic scar.
- SOFT TISSUE DAMAGE:- Mucosal loss, formation of adhesion and the organisation of haematoma within the paraglottic,

Cont'd

- Pre-epiglottic and interarytenoid space
- Arthrodesis of arytenoids into an unsatisfactory position→ web formation
- Disruption of the cartilage framework will heal by fibrous tissue
- Removal of a piece of tracheal cartilage during tracheostomy

CLASSIFICATION

- Supraglottic:- occurs at the laryngeal inlet, caused by trauma.
- Subglottic region:- narrowest, commonest.
- Glottic:-
  - Anterior glottic web from thyroid cartilage fracture, intubation, iatrogenic.
  - 3-4mm extension of a web can cause dyspnea

Cont'd

- Posterior glottic stenosis:- Intubation
- -scar tissue between the arytenoids,with fixation of one or both of them
- Subglottic region:- narrowest, commonest.
- ***Bogdasarian and Oslon*** :- Four types
- Type I- vocal cord process adhesion
- Type II- post. Commissure stenosis,with scaring in the interarytenoid plane

Cont’d

- Type III :- posterior commissure stenosis + unilateral cricoarytenoid joint ankylosis
- Type IV :- posterior commissure stenosis + bilateral cricoarytenoid joint ankylosis

cont’d

- Subglottic stenosis
- ***By Cotton Myers: -***

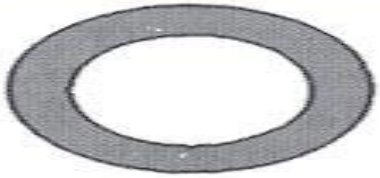
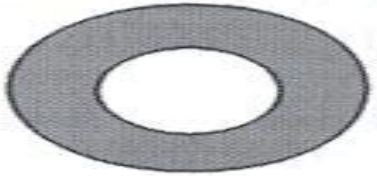
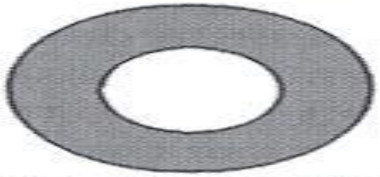
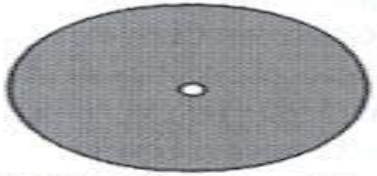
  -Grade I

  -Grade II

  -Grade III

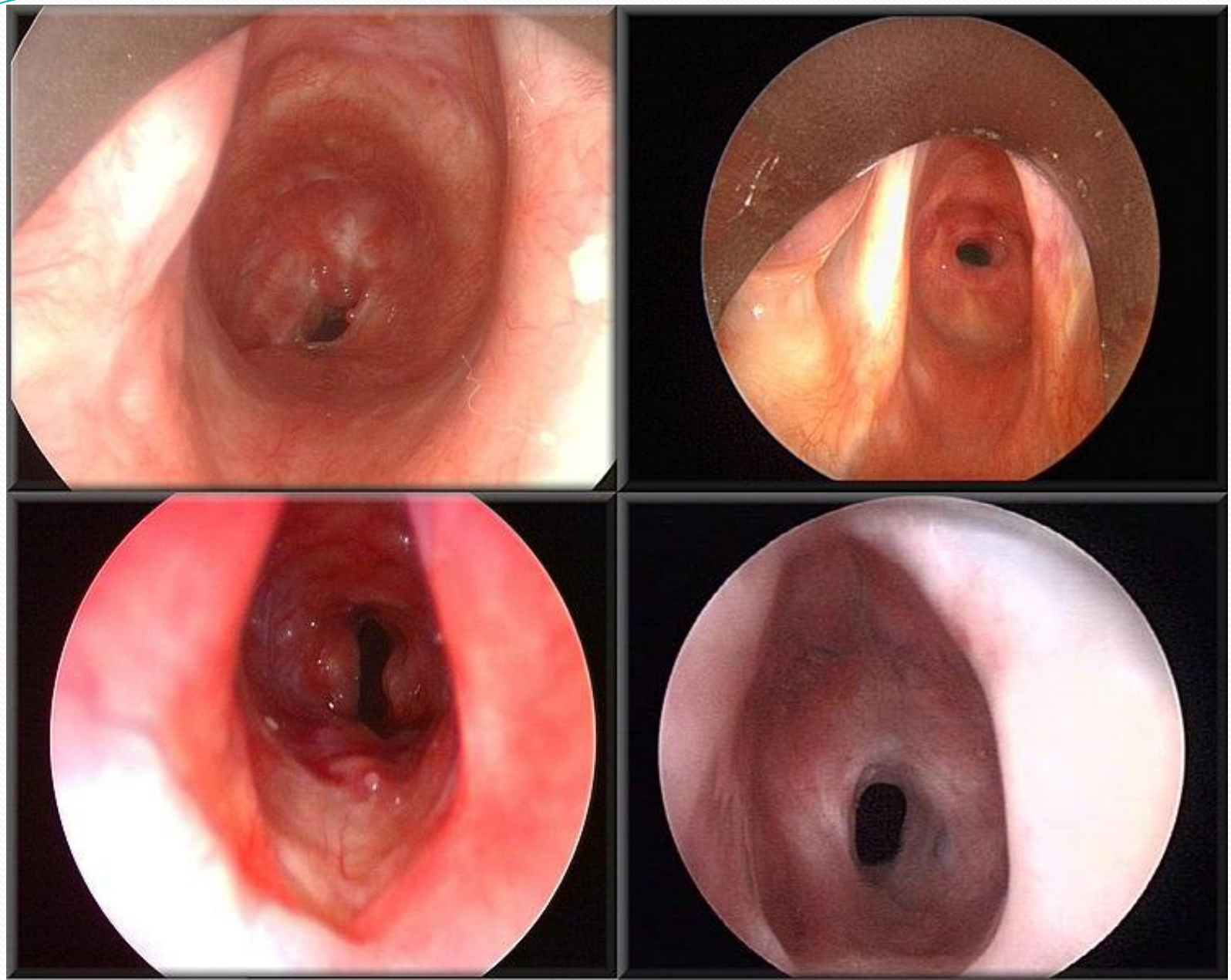
  -Grade IV

COTTON MYERS GRADING

Classification	From	To
Grade I	 No Obstruction	 50% Obstruction
Grade II	 51% Obstruction	 70% Obstruction
Grade III	 71% Obstruction	 99% Obstruction
Grade IV	No Detectable Lumen	

Cont’d

- ***Tracheal stenosis :-*** 3 types
- Cicatricia (connective tissue scar)
- Anterior wall collapse(post tracheostomy)
- Complete stenosis



LARYNGOTRACHEAL STENOSIS

-MANAGEMENT

HISTORY

- **Congenital LTS**
  - At birth

    (moderate or severe)
- **Acquired LTS**
  - 2-4 weeks Post trauma/insult

*mild form (asymptomatic,

Subsequent airway insult)

HISTORY

- Hoarse/husky voice / muffle /aphonic ,
- Difficulty in breathing
- Barking cough
- Poor cry

HISTORY

- Birth history (Prematurity)
- Feeding / Voice / Breathing difficulties?
- Reflux?
- Intubation
- Tracheostomy
- laryngeal Surgery / Interventional therapy
- RTA

HISTORY cont'd

- Burns
- Foreign body inhalation/ Aspiration
- Rheumatoid arthritis
- Infection

  (Diphtheria, Epiglottitis, TB)
- Respiratory Papillomatosis
- Tumour
- Idiopathic

PHYSICAL EXAMINATION

- Dyspnoeic ,tachypnoiec
- Stridulous
- Cyanosed
- Febrile

INVESTIGATIONS

FLEXIBLE LARYNGOSCOPY

- **Supraglottis**
  - Structure abnormalities
- **Glottis**
  - VC mobility
  - Clefts/webs/masses
- **Subglottis - stenosis**

RIGID ENDOSCOPY

- Is the gold standard
- Largest ETT
- Sites
- Length
- Other airway anomalies
  (clefts, webs, cricoarytenoid joint fixation
  neoplasms)
- Reflux changes.

LARYNGEAL INLET STENOSIS

CONGENITAL GLOTTIC STENOSIS

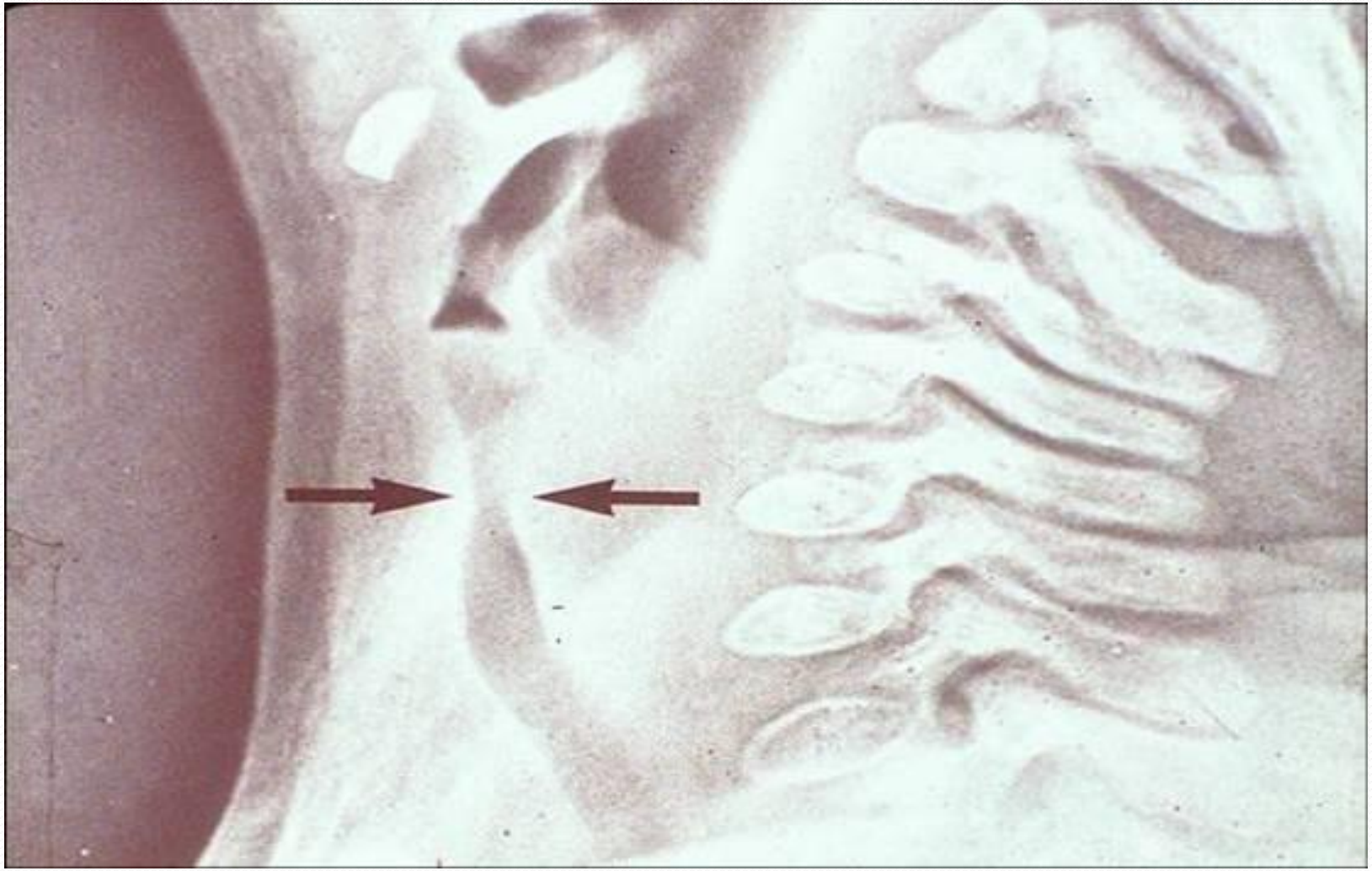
POSTERIOR GLOTTIC BAND

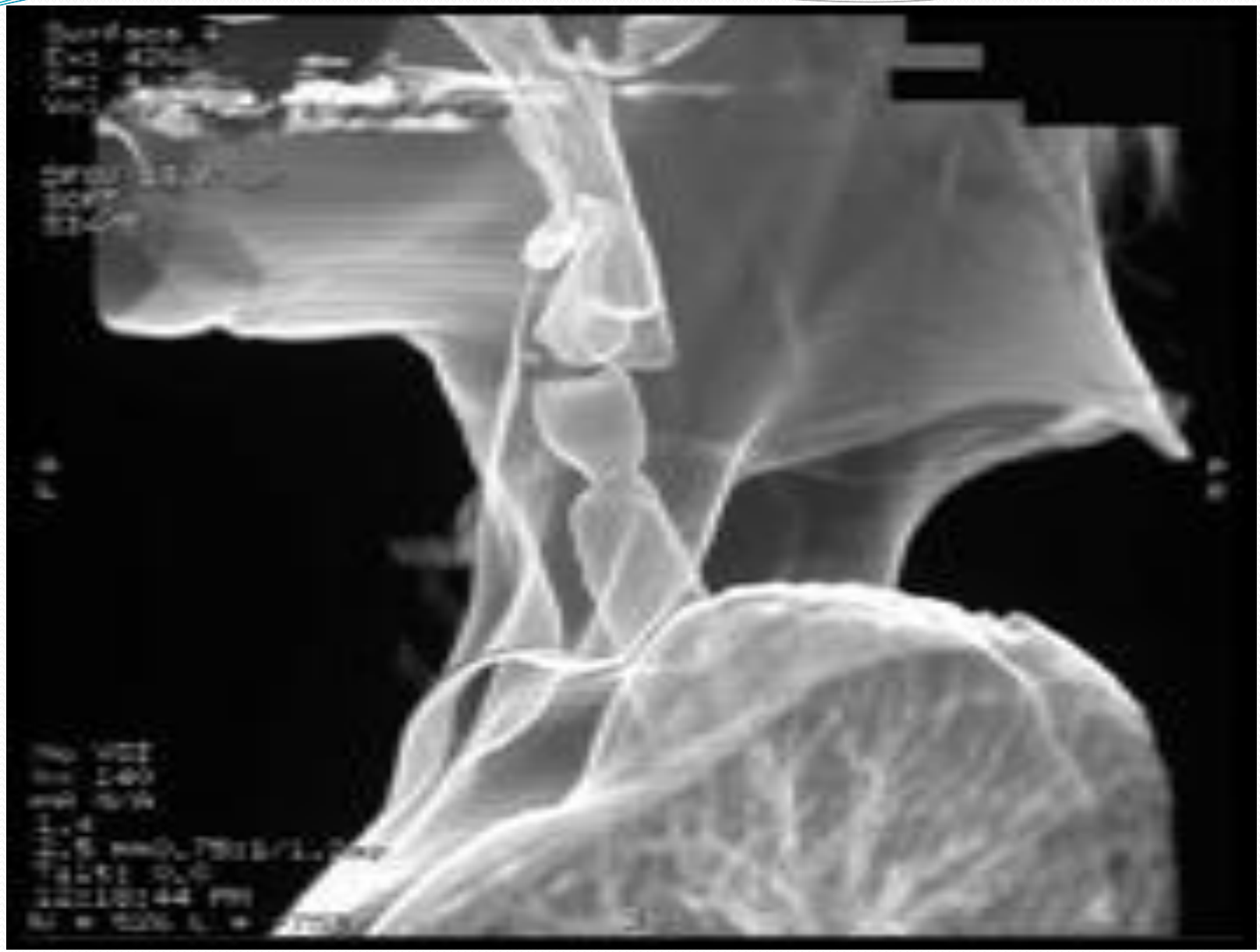
SUBGLOTTIC STENOSIS

RADIOLOGIC EVALUATION

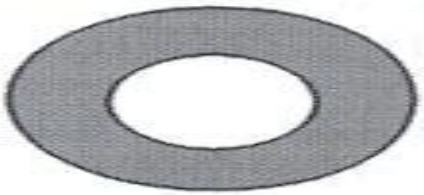
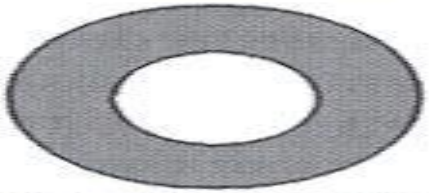
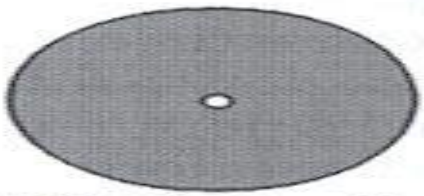
- **Plain film**
  - Quick
  - cost effective
- **CT Scan Neck**
  - Site
  - Length
- **MRI**
- **Ancilliary tests**
  - surgical planning

Soft Tissue Film (xeroradiograph)





Cotton-Myer Grading

Classification	From	To
Grade I	 No Obstruction	 50% Obstruction
Grade II	 51% Obstruction	 70% Obstruction
Grade III	 71% Obstruction	 99% Obstruction
Grade IV	No Detectable Lumen	

McCaffrey (1992)

- subsites (trachea, subglottis, glottis)
- length of stenosis
- not lumen diameter

- Grade I: subglottis or trachea
  <1cm long
- Grade II: subglottis
  >1cm long
- Grade III: Subglottic and tracheal
- Grade IV: Glottic involvement

DIFFERENTIAL DIAGNOSIS

- Laryngomalacia
- Tracheomalacia
- Vocal cord paralysis
- Laryngeal cleft
- Congenital cysts
- Mass
- Hemangioma
- Viral laryngotracheobronchitis (croup)
- GERD
- Recurrent respiratory papillomatosis
- Foreign body

- TREATMENT

GOAL

- To produce:
  1. Adequate airway
  2. Competent Larynx
  3. Acceptable voice

*Ultimately the goal is to treat the stenotic segment while preserving native normal segments

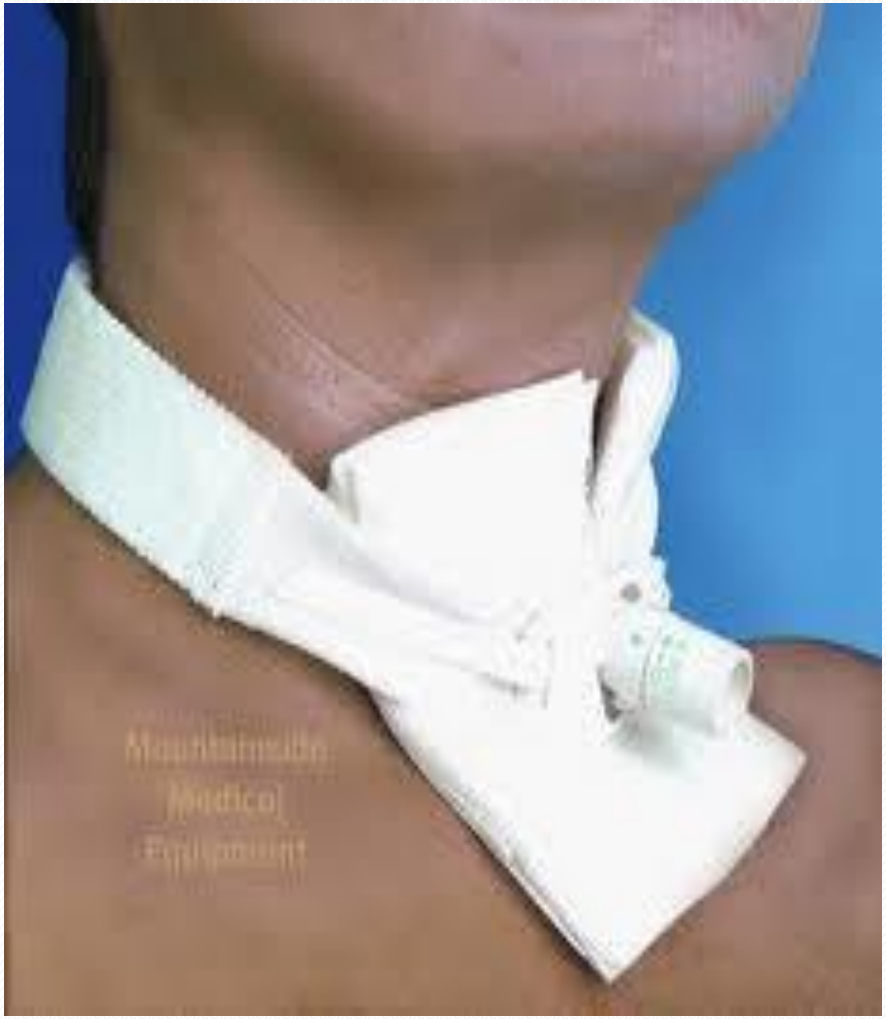
TREATMENT -OPTIONS

- Tracheostomy

- Endoscopic
  - -Dilation
  - -Laser excision

- Open procedure:
  - -Expansion procedure (one-stage , with stent)
  - -Segmental resection (cricotracheal resection - CTR)

TRACHEOSTOMY



TRACHEOSTOMY

- Adequate airway
- Smallest tube
- Allows air leakage
  (pressure injury, phonation).
- Temporary

*(suprastomal granulation tissue --> failed decannulation)

*accidental decannulation

ENDOSCOPIC REPAIR

- **Dilation**
  - Early disease

- **Scar excision with laser**
  - Minimal damage
  - Avoids bleeding, edema,
- Grade I or II stenosis
- Requires multiple procedures

TRACHEAL DILATATION

RIGID BRONCHOSCOPE

CO_2 LASER

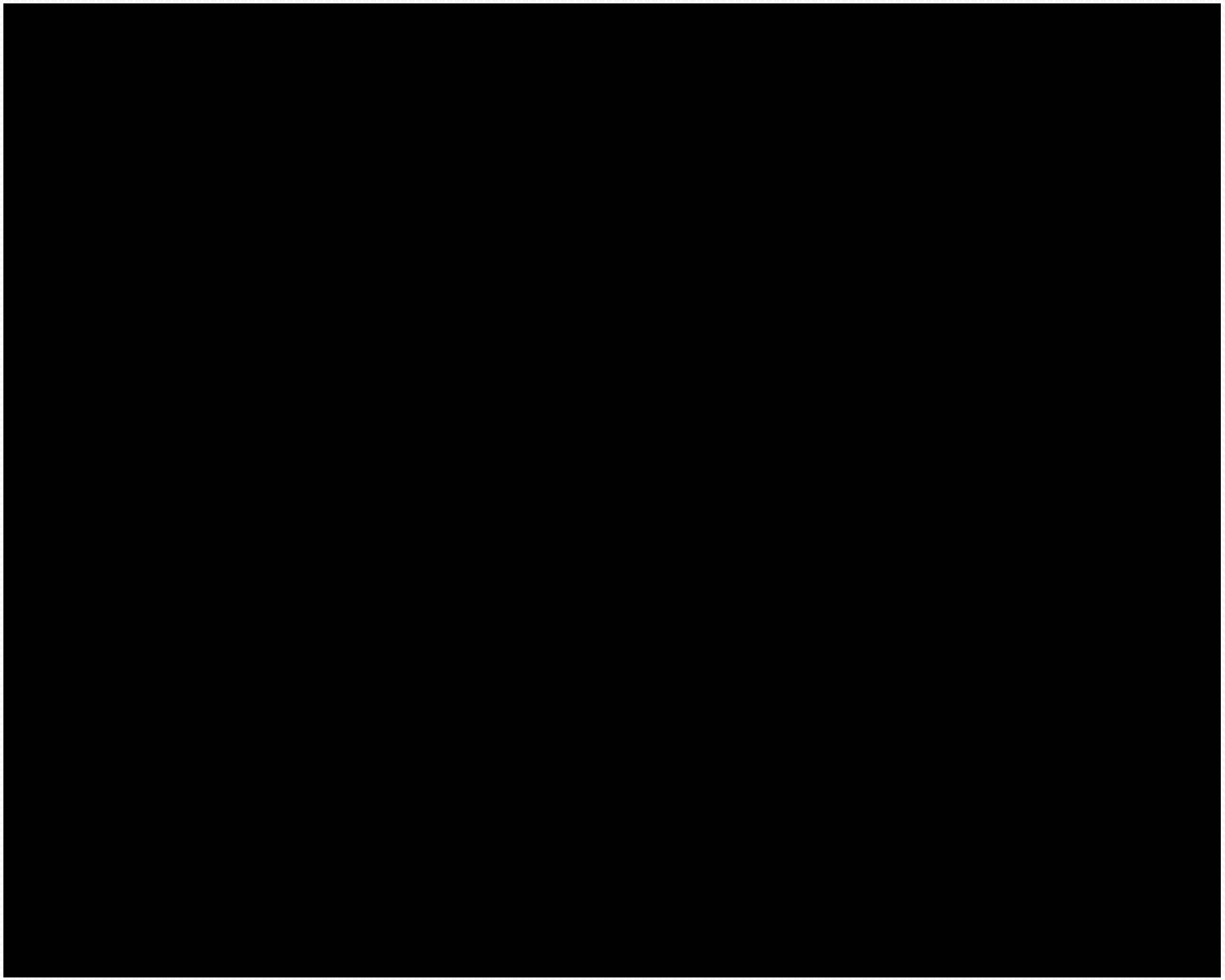
Open procedure --LTR

-Expansion procedure (one-stage , with stent)

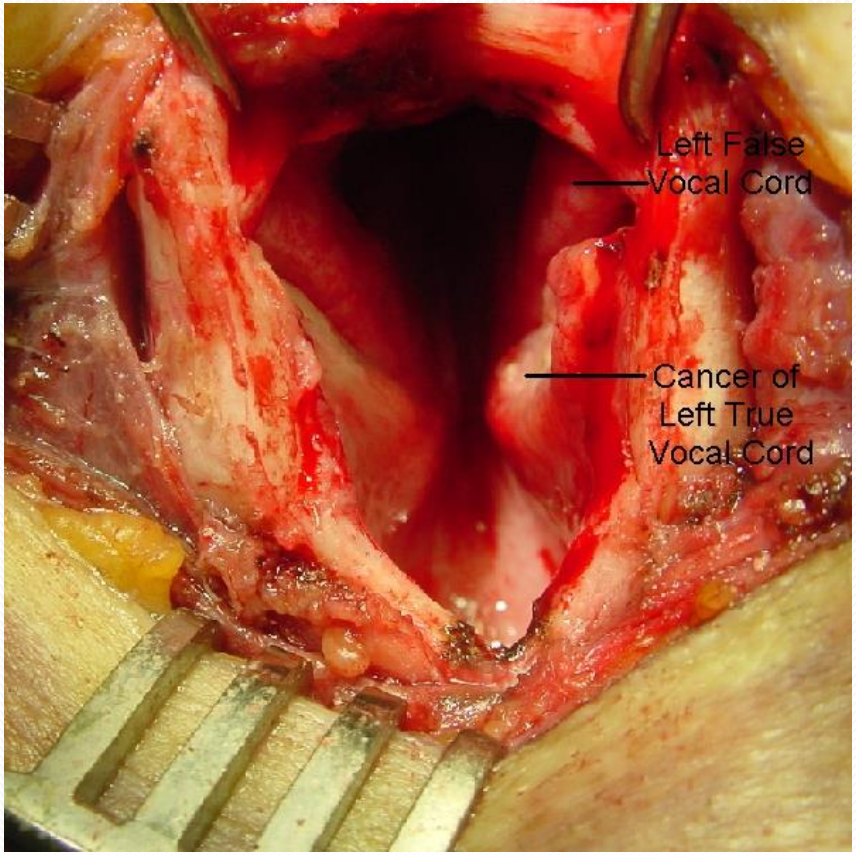
* Anterior cricoid split +/_cartilage graft*
* Posterior cricoid split +/_cartilage graft*
*Anterior and posterior cricoid split with cartilage graft

-Segmental resection (cricotracheal resection - CTR)

* Primary CTR
*Salvage CTR
*Extended CTR – CTR +/_expansion



OPEN REPAIRS



- LARYNGOFISSURE

External Expansion Surgery

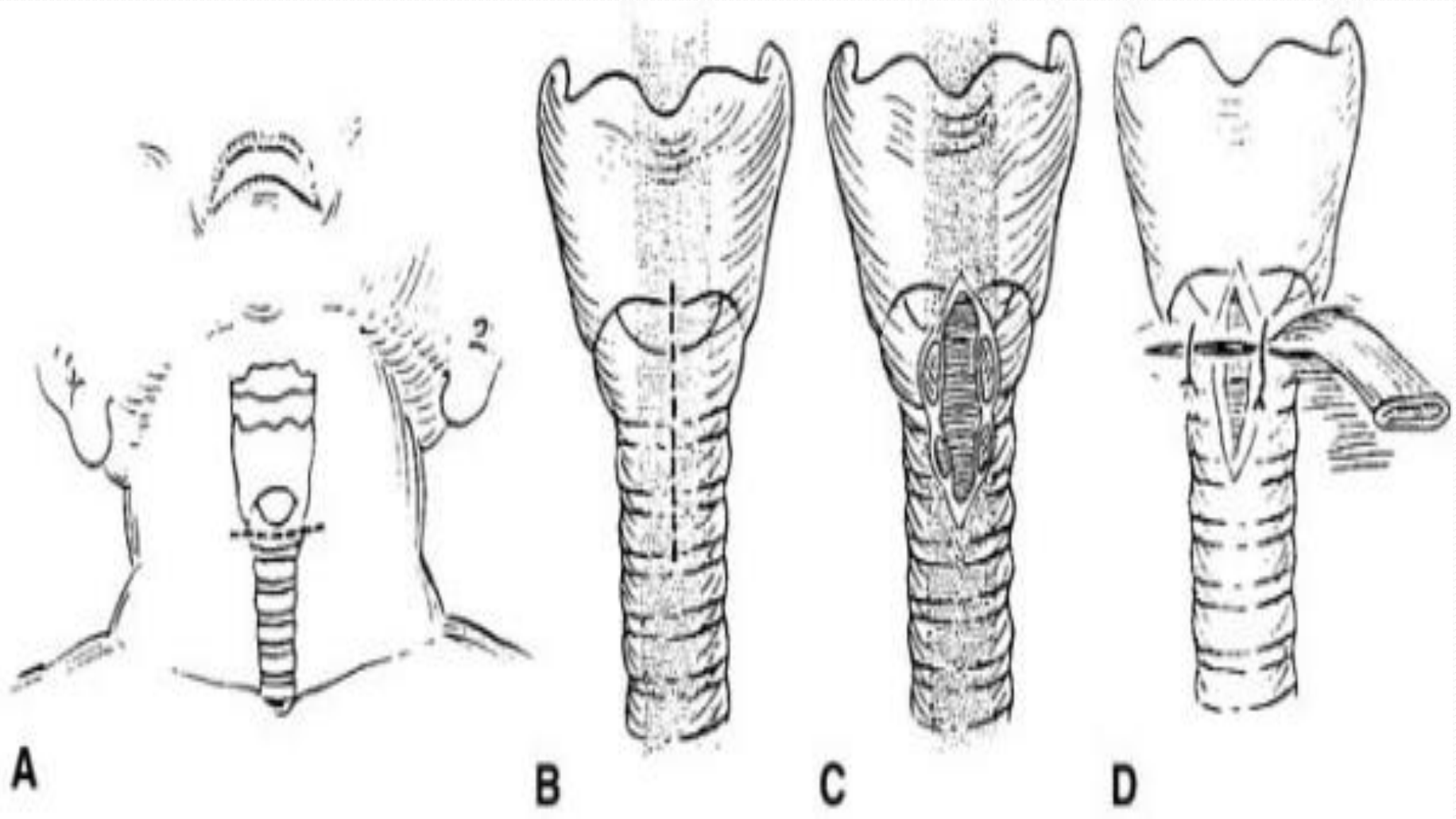
- Grade III and IV stenosis,
- Refractory grade II
- Cricoid split + cartilage grafts + stenting

- Repair at youngest age possible:
  - Improved speech and language development
  - Decreased tracheostomy mobidity/mortality

ANTERIOR CRICOID SPLIT

- 1980 – Cotton
- Alternative (Tracheostomy)
  - Splits cricoid and first 2 tracheal rings
  - ET tube in place (stent).
  - ICU -Intubated, sedated, paralyzed 7-14 days
- Mild anterior narrowing

ANTERIOR CRICOID SPLIT



Anterior Grafts: Modified boat shape

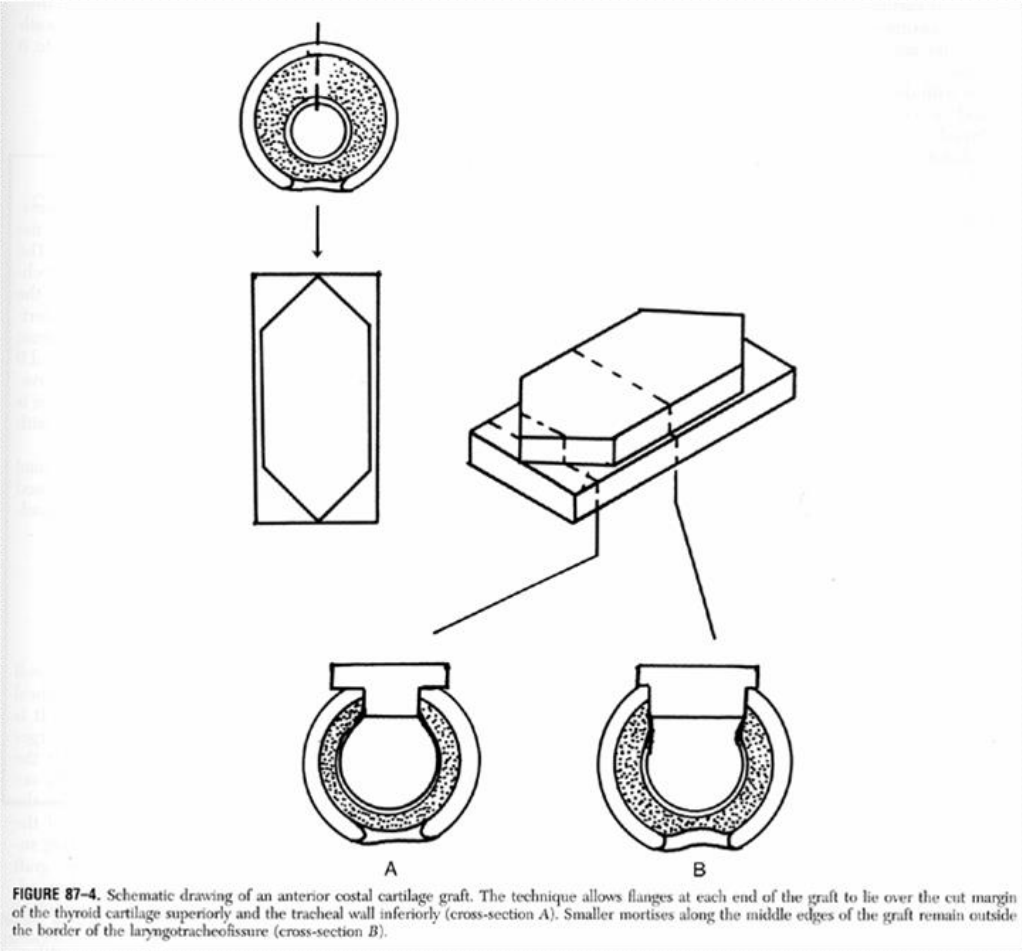
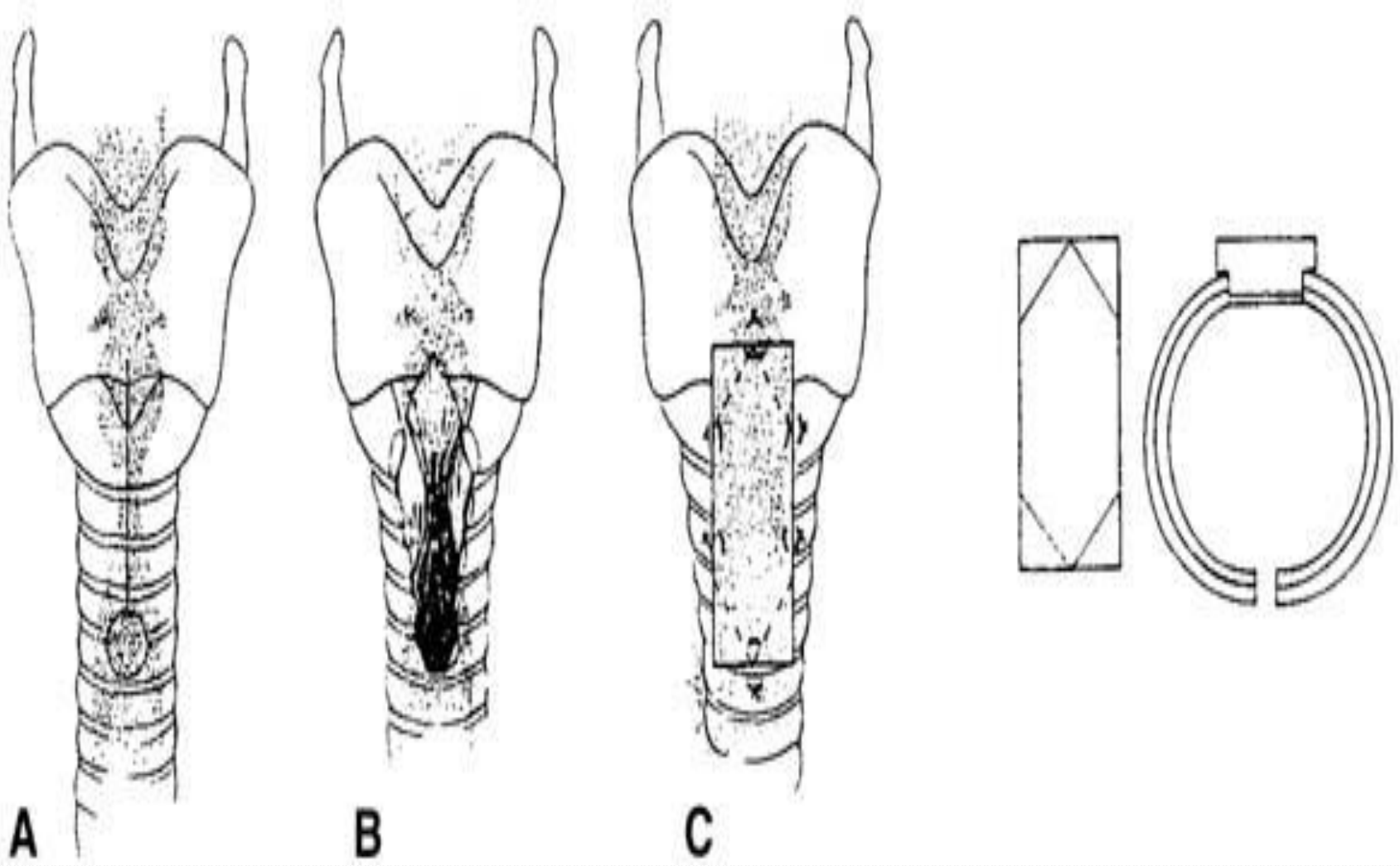


FIGURE 87–4. Schematic drawing of an anterior costal cartilage graft. The technique allows flanges at each end of the graft to lie over the cut margin of the thyroid cartilage superiorly and the tracheal wall inferiorly (cross-section *A*). Smaller mortises along the middle edges of the graft remain outside the border of the laryngotracheofissure (cross-section *B*).

Placement of anterior graft



Costal Cartilage Grafts

- Abundant
- Can obtain any size necessary
- Generally use the 5^{th} rib
- Stenting (several days)

Approach to obtaining graft

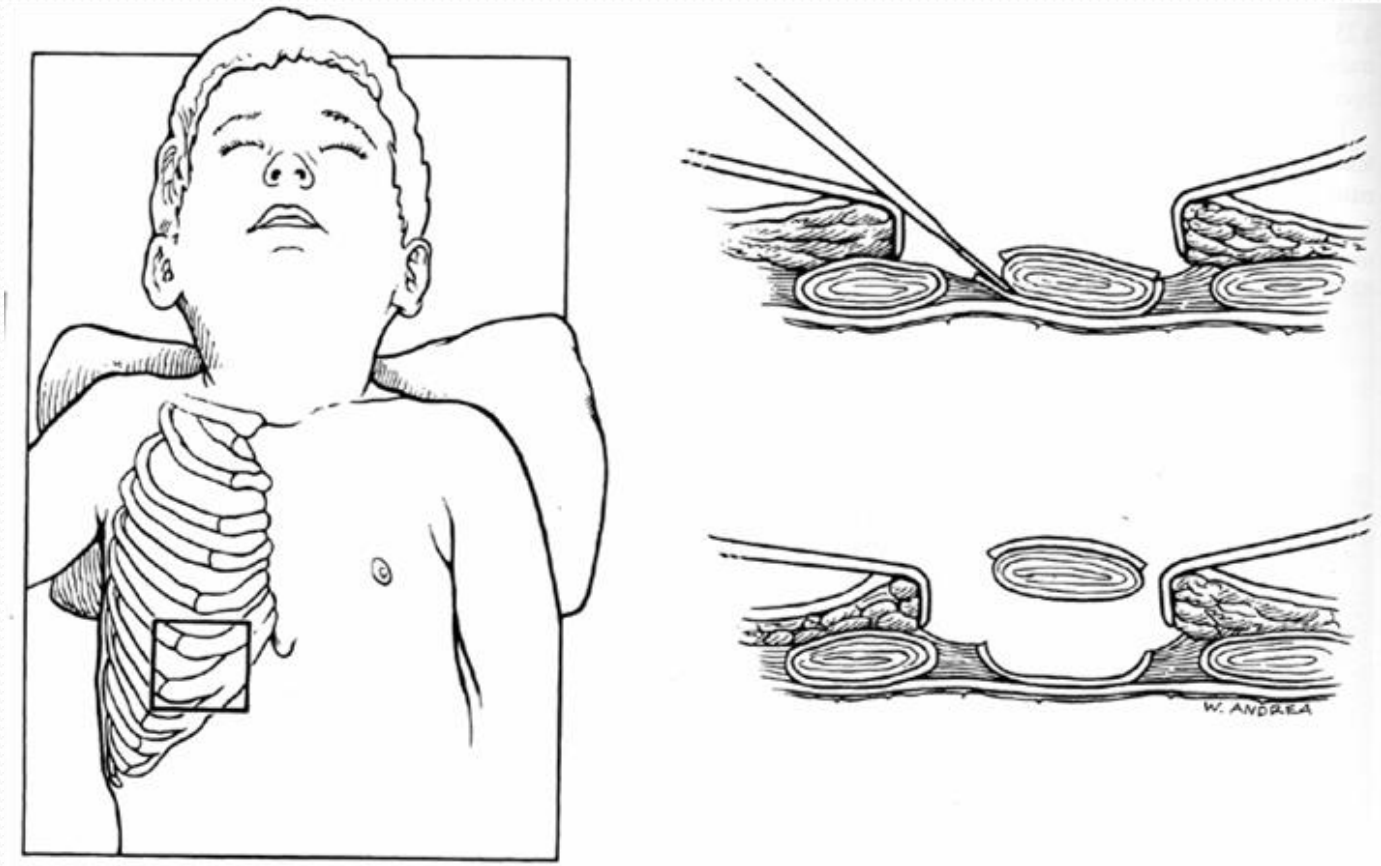


Figure 11-15. Costal cartilage graft donor site: right lower ribs. The deep layer of perichondrium remains in the patient.

Other grafts

- Auricular cartilage
- Thyroid alar cartilage
- Hyoid bone

Anterior laryngofissure with graft

- Good for:
  - Anterior stenosis
  - Anterior wall collapse
- Perichondrium of the anterior graft is placed on the lumen side
  - Re-epithelialization
  - Barrier to infection
- Large external flange (prolapse)

Laryngofissure with posterior cricoid division +/- grafting

- Indications:
  - Posterior subglottic or glottic stenosis
  - Circumferential stenosis
  - Cricoid deformity
- Key points / complications
  - Avoid complete laryngofissure to avoid damage to anterior commissure
  - Knots buried to keep them extraluminal
  - Patients often receive stenting 3-6 months

Posterior Grafts: boat shape

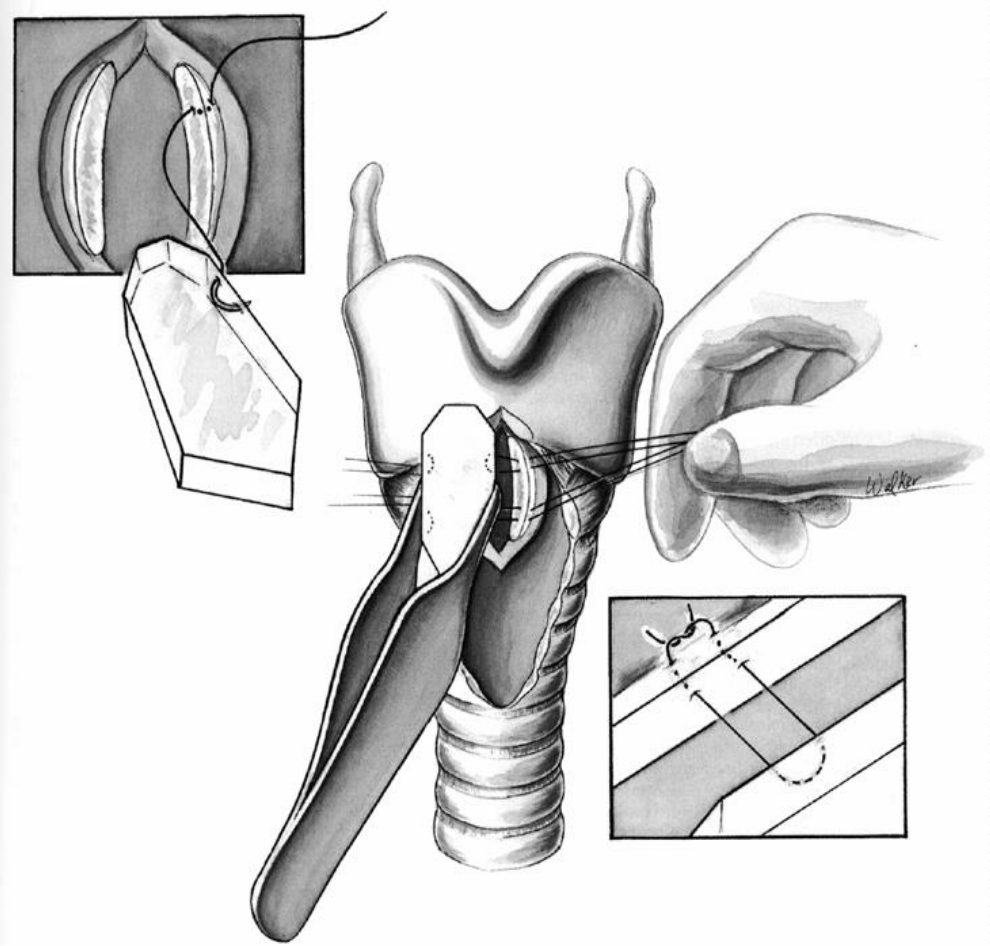


FIGURE 87–7. Placement of a graft of costal cartilage in the divided posterior lamina of the cricoid cartilage. (From Cotton RT. Pediatric laryngotracheal reconstruction. Op Tech Otolaryngol Head Neck Surg 3:168, 1992.)

Single-staged Laryngotracheal Reconstruction (SS-LTR)

- Allows for shorter stenting period
- Anterior graft, posterior graft, or both
- ET tube initially to support the graft
  - 2-4 days if Anterior graft only
  - 7 days if Posterior graft is used as well
- Best results if patient >4Kg and >30wks

Two-Staged LTR

- The main difference is that a more permanent stent is used to maintain the airway while the graft heals
  - Montgomery T-tubes (silastic)
  - Aboulker Stents (teflon)
- Stents can be left for months

*Considered to be inert and prevent tissue injury

STENTS

- Counteract scar contractures
- Scaffold for the airway.
- Hold grafts in place
- **Types**

  -Endotracheal tubes,

  -Silastic sheet rolls,

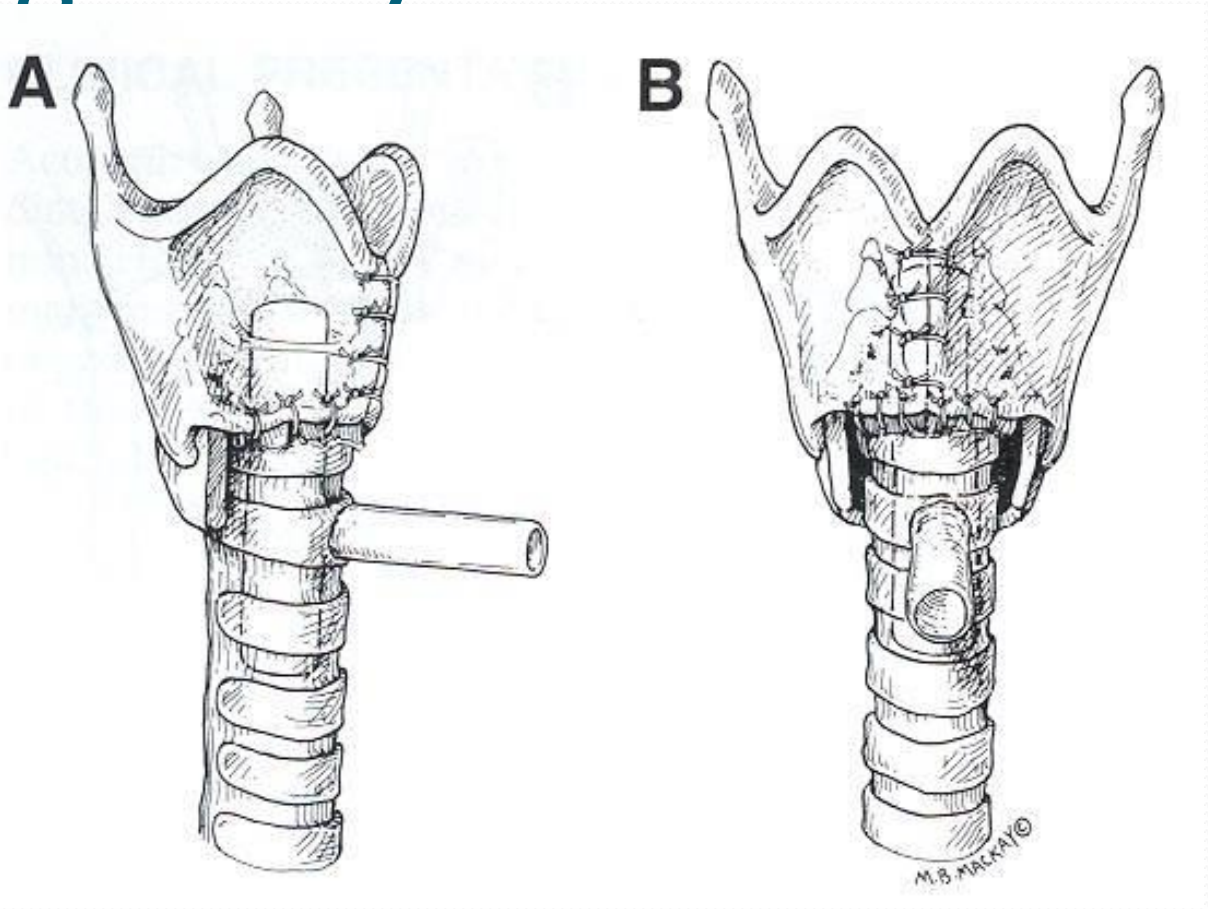
  -Montgomery T-tubes,

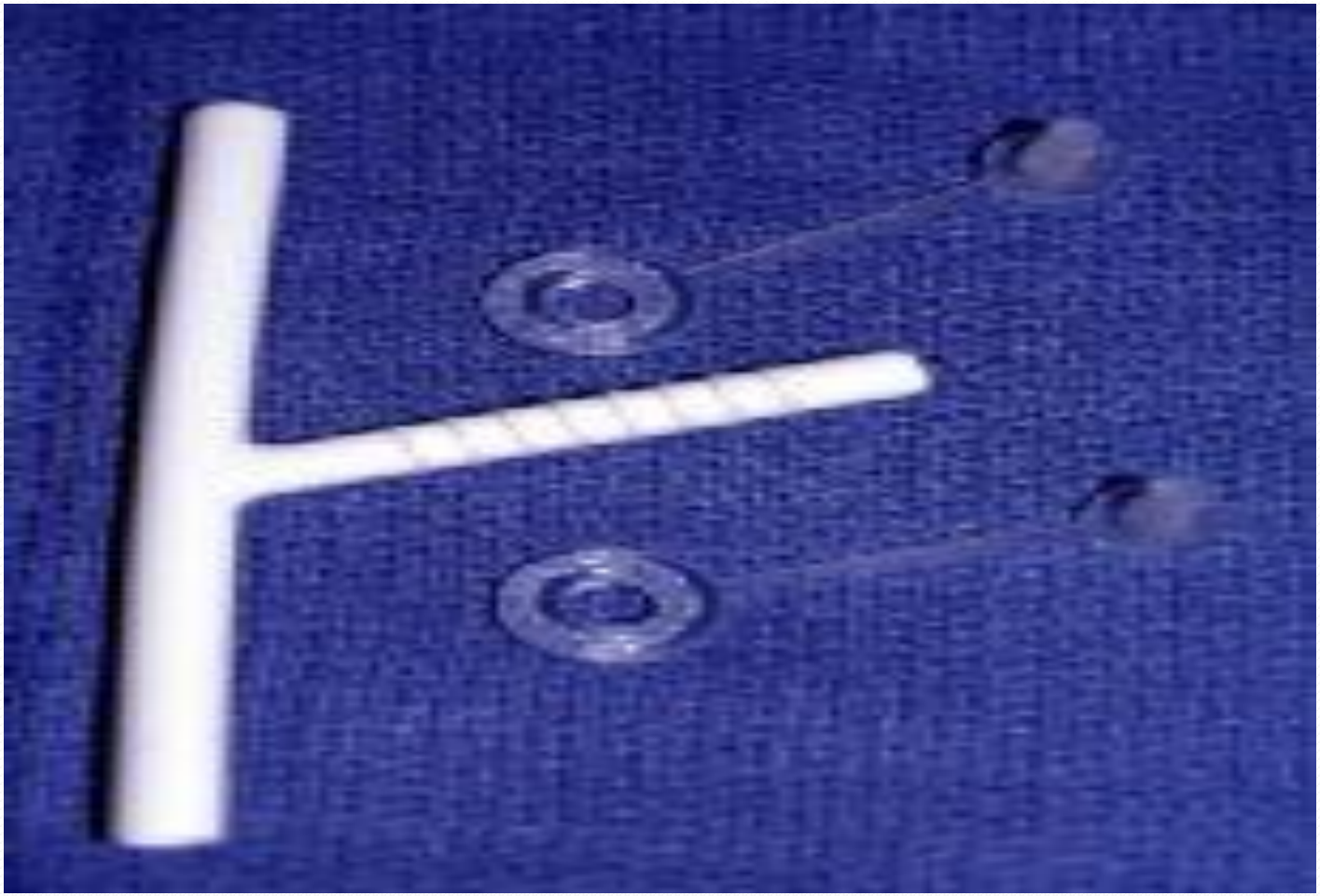
  -Laryngeal stents :

  *Teflon stents [Aboulker stent ,

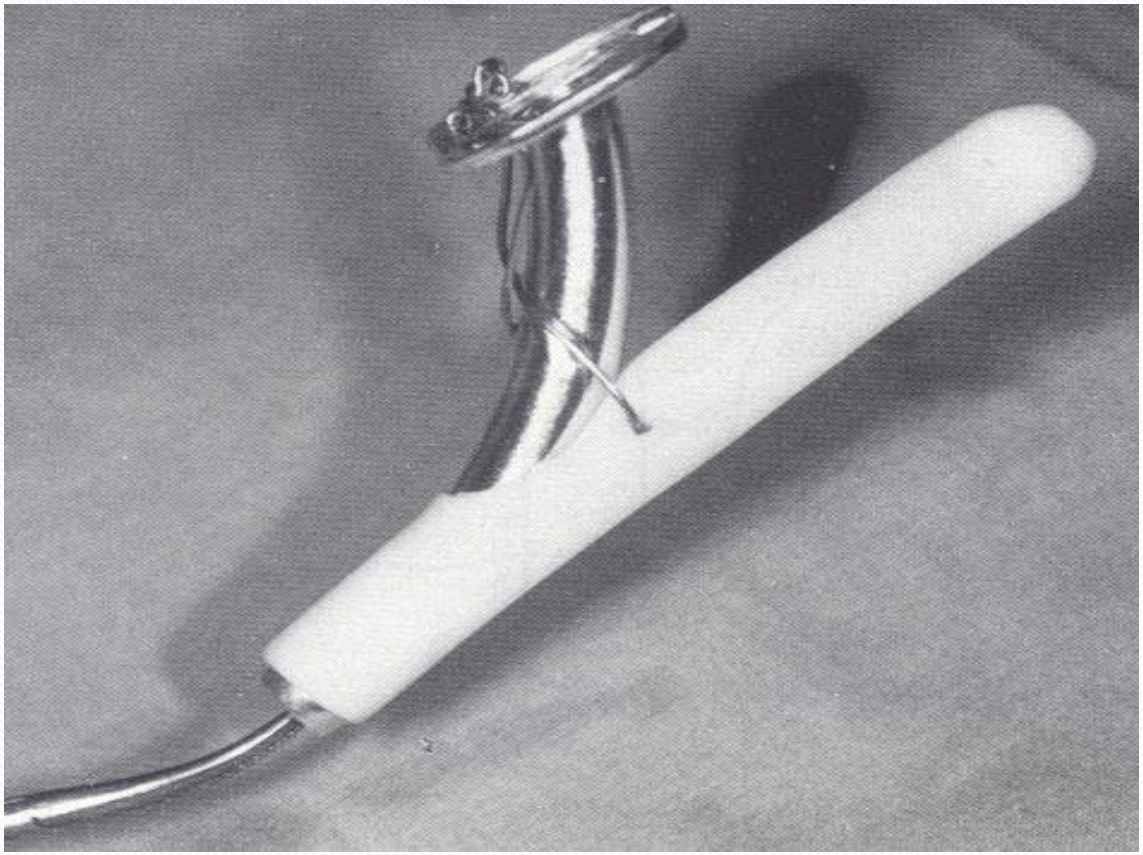
  *Silastic stents (Montgomery stents:

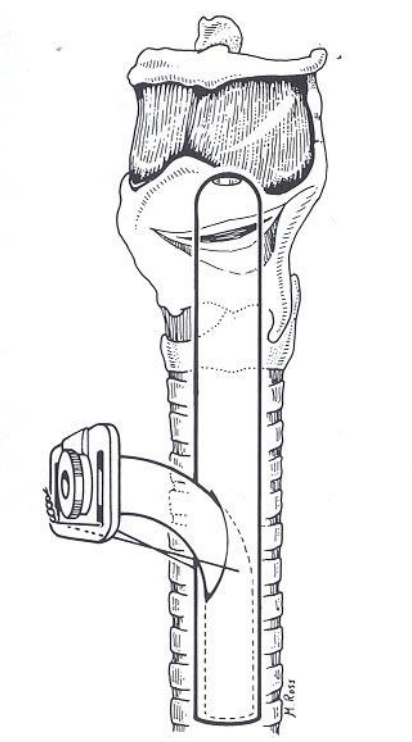
Montgomery T-tube Stent





Aboulker Stent



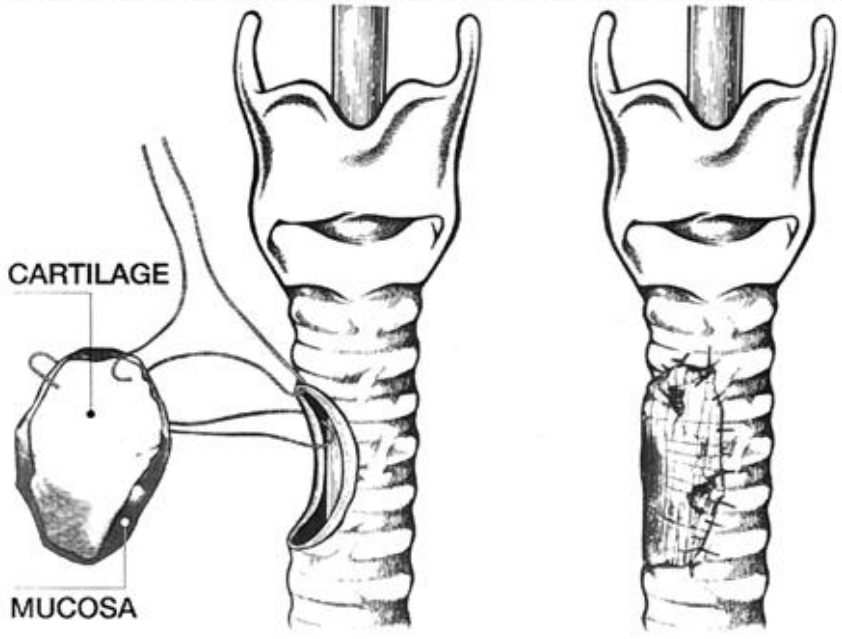


Aboulker Stent: wired-in tracheostomy tube

Stent complication

- Granulation tissue formation
- S. aureus and P.aeruginosa
- Antibiotics .

TRACHEAL RECONSTRUCTION



composite nasal septal cartilage graft

TRACHEAL RECONSTRUCTION

Cryo-preserved aortic allograft.

Cricotracheal Resection (CTR)

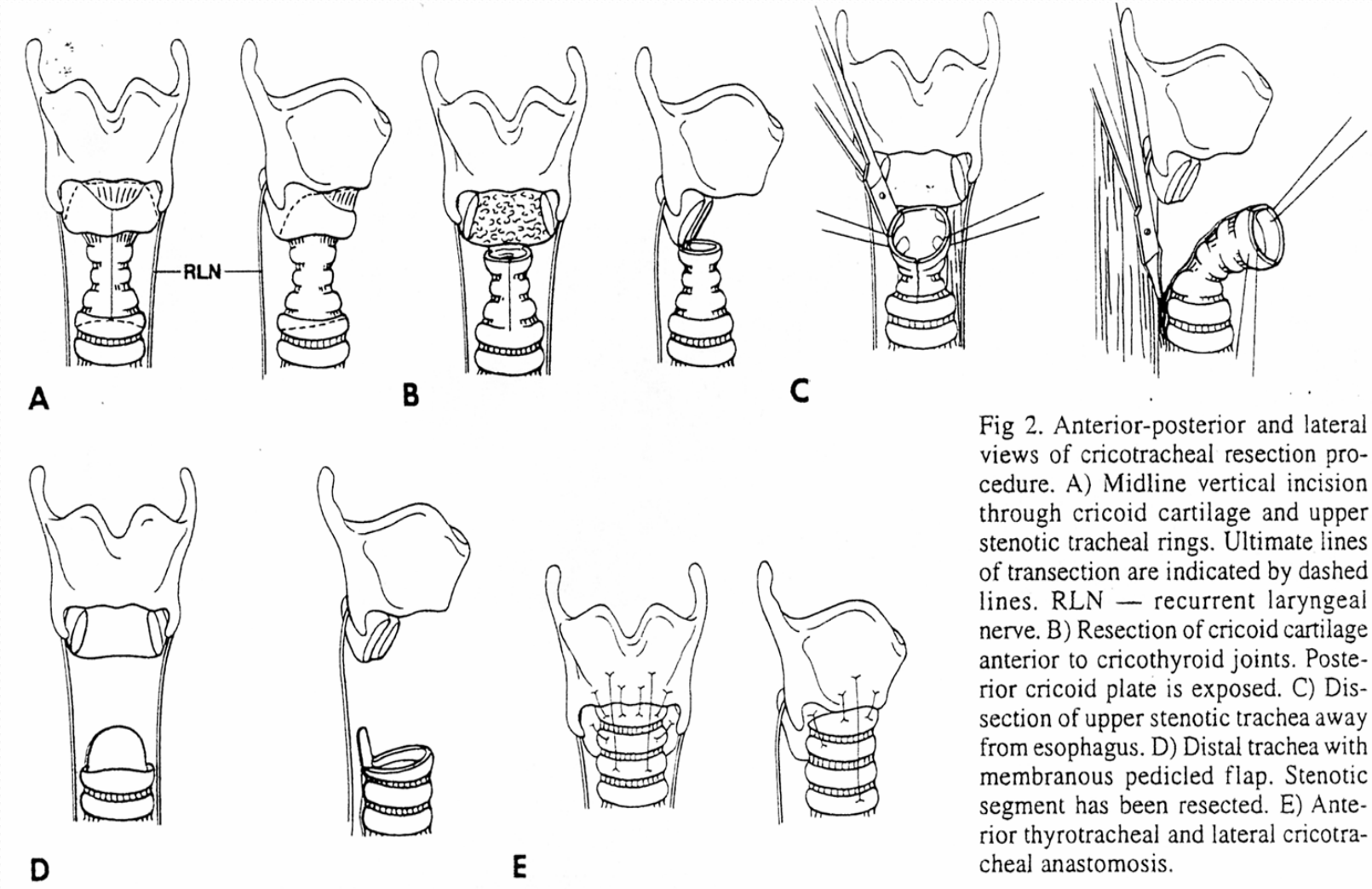
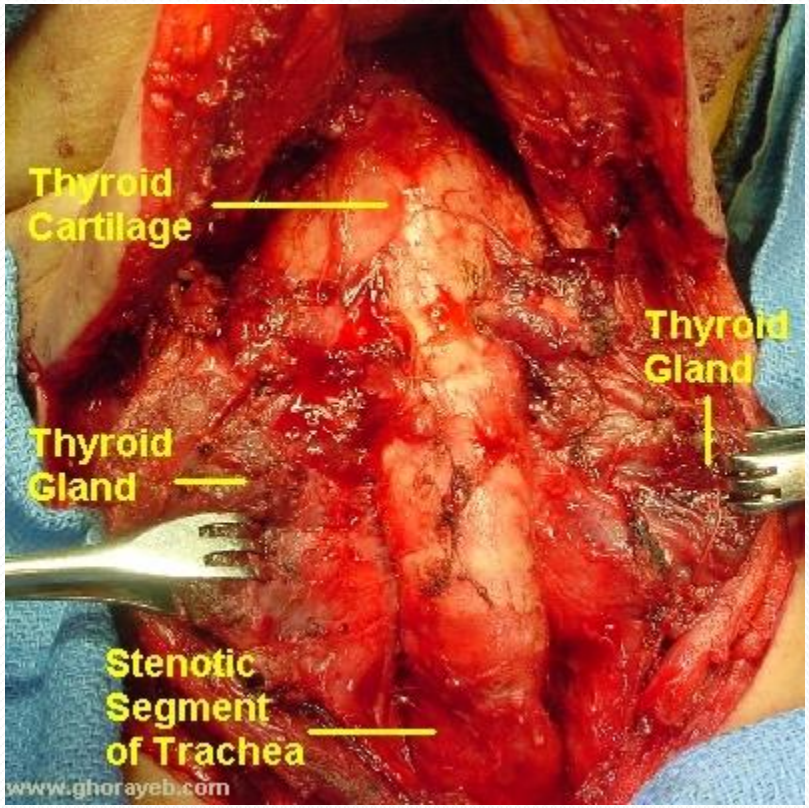
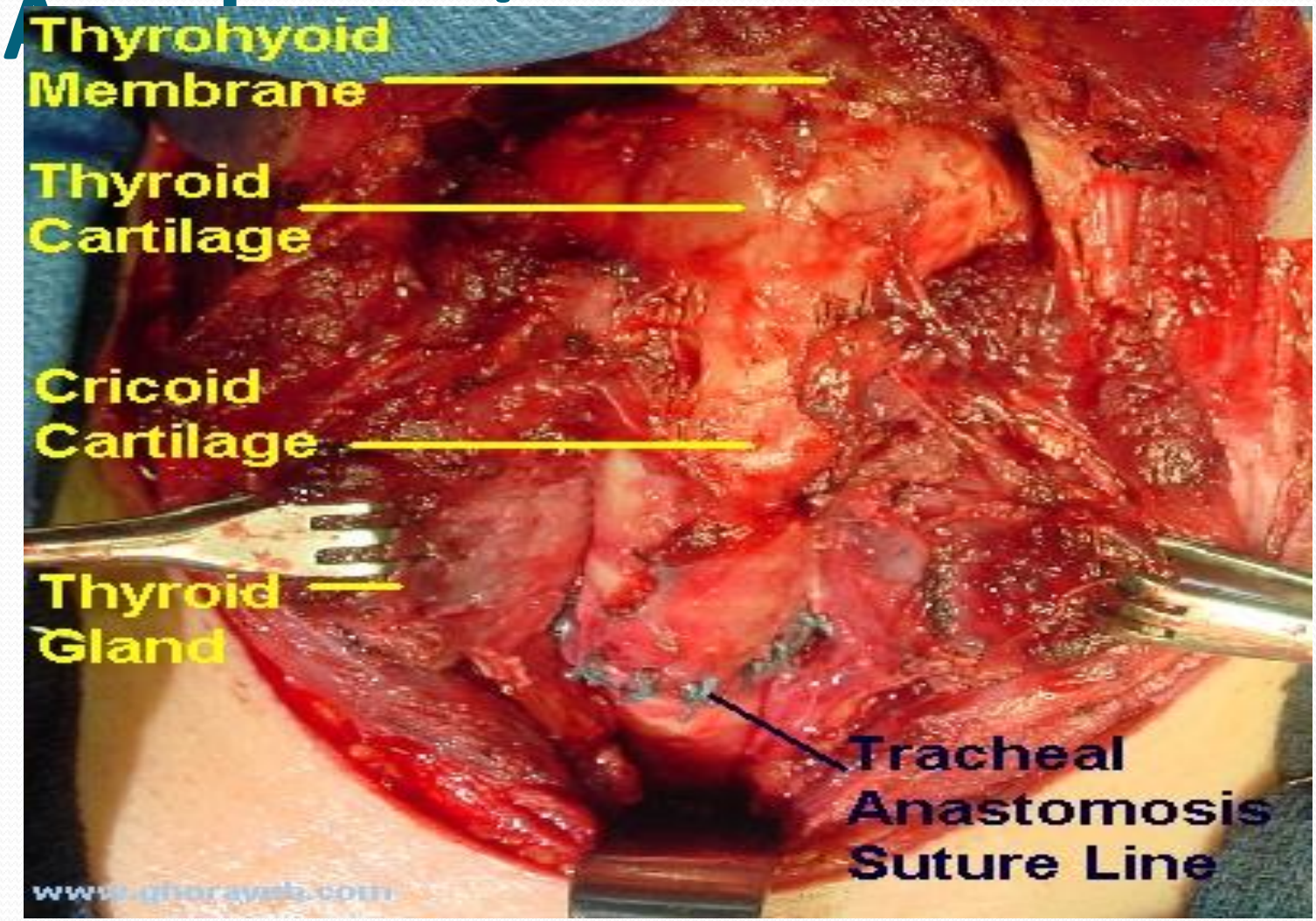


Fig 2. Anterior-posterior and lateral views of cricotracheal resection procedure. A) Midline vertical incision through cricoid cartilage and upper stenotic tracheal rings. Ultimate lines of transection are indicated by dashed lines. RLN — recurrent laryngeal nerve. B) Resection of cricoid cartilage anterior to cricothyroid joints. Posterior cricoid plate is exposed. C) Dissection of upper stenotic trachea away from esophagus. D) Distal trachea with membranous pedicled flap. Stenotic segment has been resected. E) Anterior thyrotracheal and lateral cricotracheal anastomosis.

Tracheal Resection and Anastomosis



Tracheal Resection and A



CTR Complications

- Anastomotic webbing
  - asymptomatic
- Arytenoid prolapse (45%)
  - Asymptomatic
  - partial laser arytenoidectomy
- Restenosis
  - Tracheostomy dependent
- Postoperative infection
- Recurrent laryngeal nerve palsy
- Anastomotic dehiscence

POST – OP CARE

- ICU
- Nasotracheal Intubation 7-14 days
- Sedation and paralysis
- Steroids
  - 12 hours preop
  - 5 days after decannulation
- Leak test prior to extubation
- Precedex during tracheal extubation
- Antibiotics
  - 2 weeks
  - MonthsAnti-reflux medications
- Chest physiotherapy

PREVENTION

- Awareness & Education
- Good ANC
- Duration (Tracheostomy)
- Technique (Traumatic intubation)
- Size / type
- Movement
- Number of re-intubations,
- Infection while intubated
- High tracheostomy

RECENT ADVANCES

Transplanted trachea

+ stem cells

(Ciaran's stem cells)

LOCAL EXPERIENCE

- 4 confirmed cases
- 3 (F) 1 (M)
- 4 undocumented

CONCLUSION

- Laryngotracheal stenosis
- Rare condition
- Prolonged intubation
- Management very challenging

THANK YOU

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