

TRACHEOSTOMY

Kishore SANDU



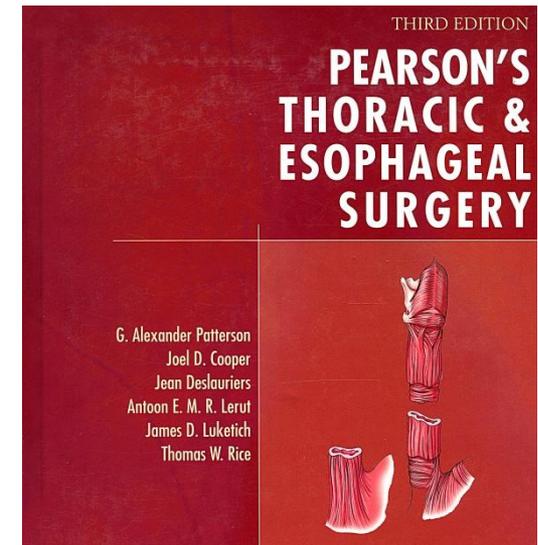
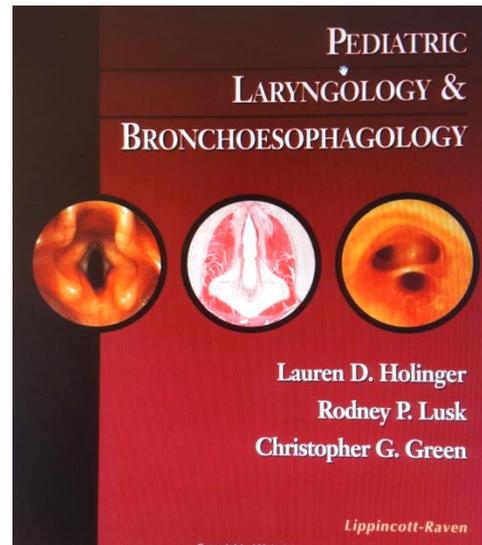
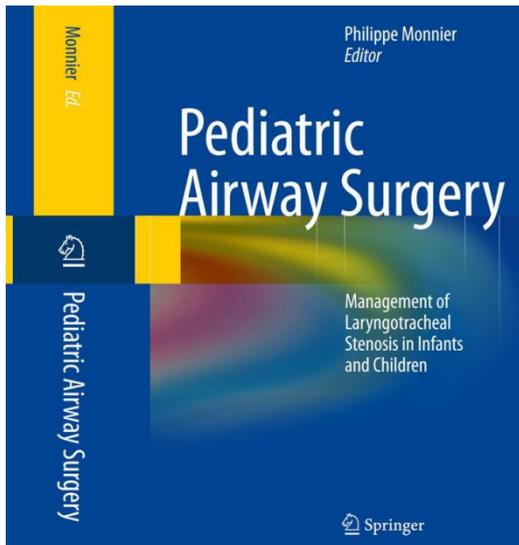
**Centre hospitalier
universitaire vaudois**



**Department of Otolaryngology &
Head - Neck Surgery
University Hospital
Lausanne, Switzerland**

DISCLOSURES & CONFLICTING INTERESTS

1. No financial relation with the industry
2. Images taken for CME purposes from:
 - PHOTO BANK ARCHIVES – ORL DEPT, CHUV, **Marion BRUN**
 - REFERENCE BOOKS





- Stress
 - parents
 - doctors
 - hospital staff

- Death

- Growth retardation
 - speech
 - feeding

- COSTLY

Tracheostomy vs T' tomy

≤ 1960's

- treatment of **airway obstructions** (FBs) ,
acute infections (epiglottitis, abscesses, LTBitis)
- currently

SUMMARY OF INDICATIONS

- **Upper airway obstruction**
 - > LTS (including BVFP, UVFP)
 - > OSA-related narrowings
(including craniofacial deformities)
- **Prolonged ventilator dependence**
 - > cardiopulmonary disease
- **Pulmonary toilet**
 - > neurologic impairment
 - > LTEC, LT-fistula

BIASES IN INDICATIONS

- Expertise in infant CPAP and BIPAP
- **Referral patterns**
 - > neurological problems
 - > cardiopulmonary diseases
 - > upper airway obstruction
 - LTS
 - craniofacial anomalies
 - > trauma center

! GREAT VARIETY AMONG DIFFERENT CENTERS !

CCH= 12-15/y; GOSH = 50/y(personal comm.); CHUV < 2/3yrs

ALTERNATIVES



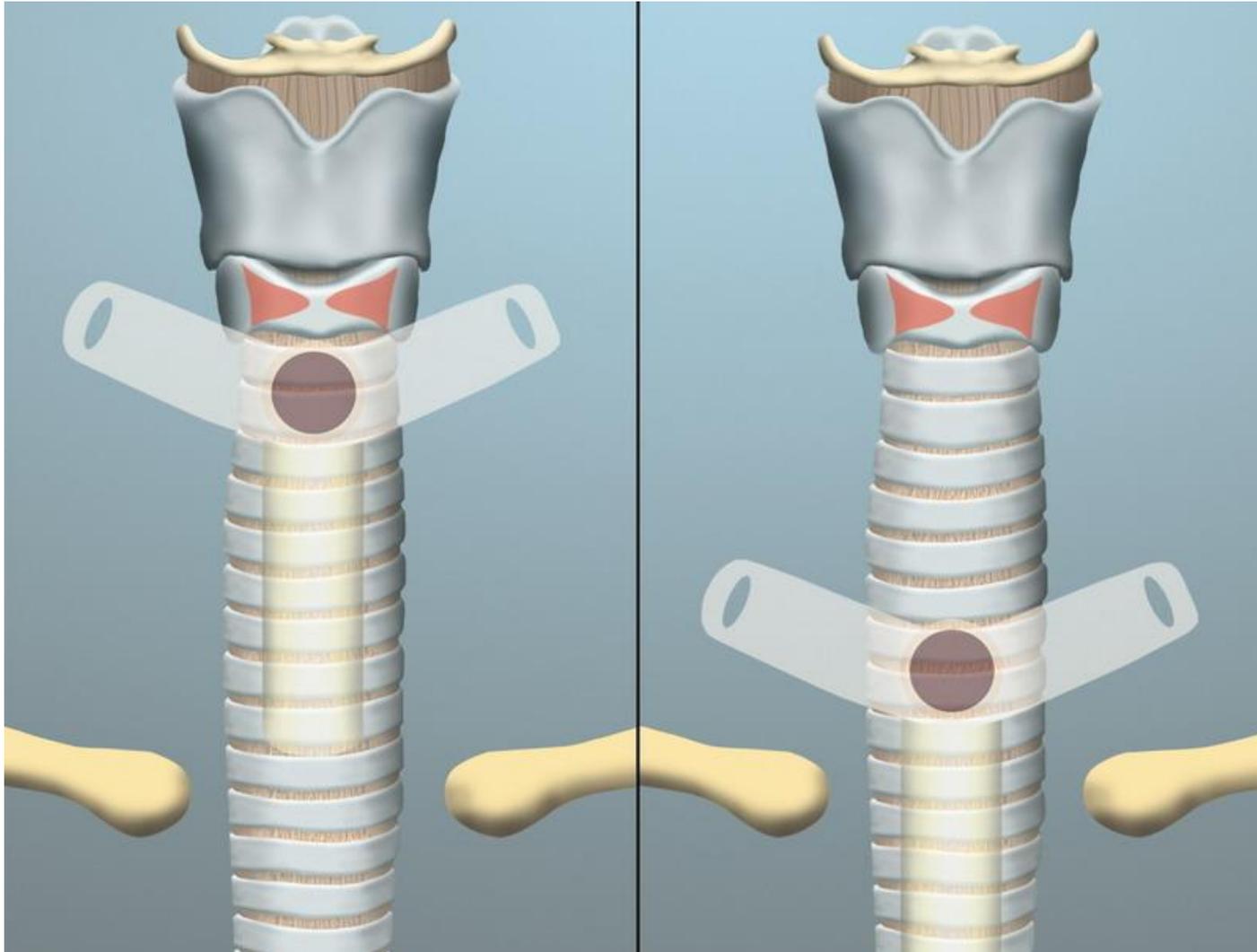
- Prolonged intubation
> premature babies
- Short-term intubation or face-mask with CPAP/BIPAP
> acute upper airway infections
> temporary ventilatory support

! DECREASE IN NUMBER OF TRACHEOTOMIES !

- For **ventilatory support or lung protection**
 - > 3rd - 4th ring
- For **incipient LTS**
 - > 1st ring or 6th - 7th ring (* anticipated DS procedure in the future
* ! risk of stoma - related stenosis!)
- For **(incipient) tracheal stenosis**
 - > through tracheal stenosis (! emergency tracheal R&A !)
- For **intrathoracic tracheal stenosis**
 - > low in the neck with long « stenting » cannula
- For **recurrent tracheostomy stenosis**
 - > through former tracheostomy

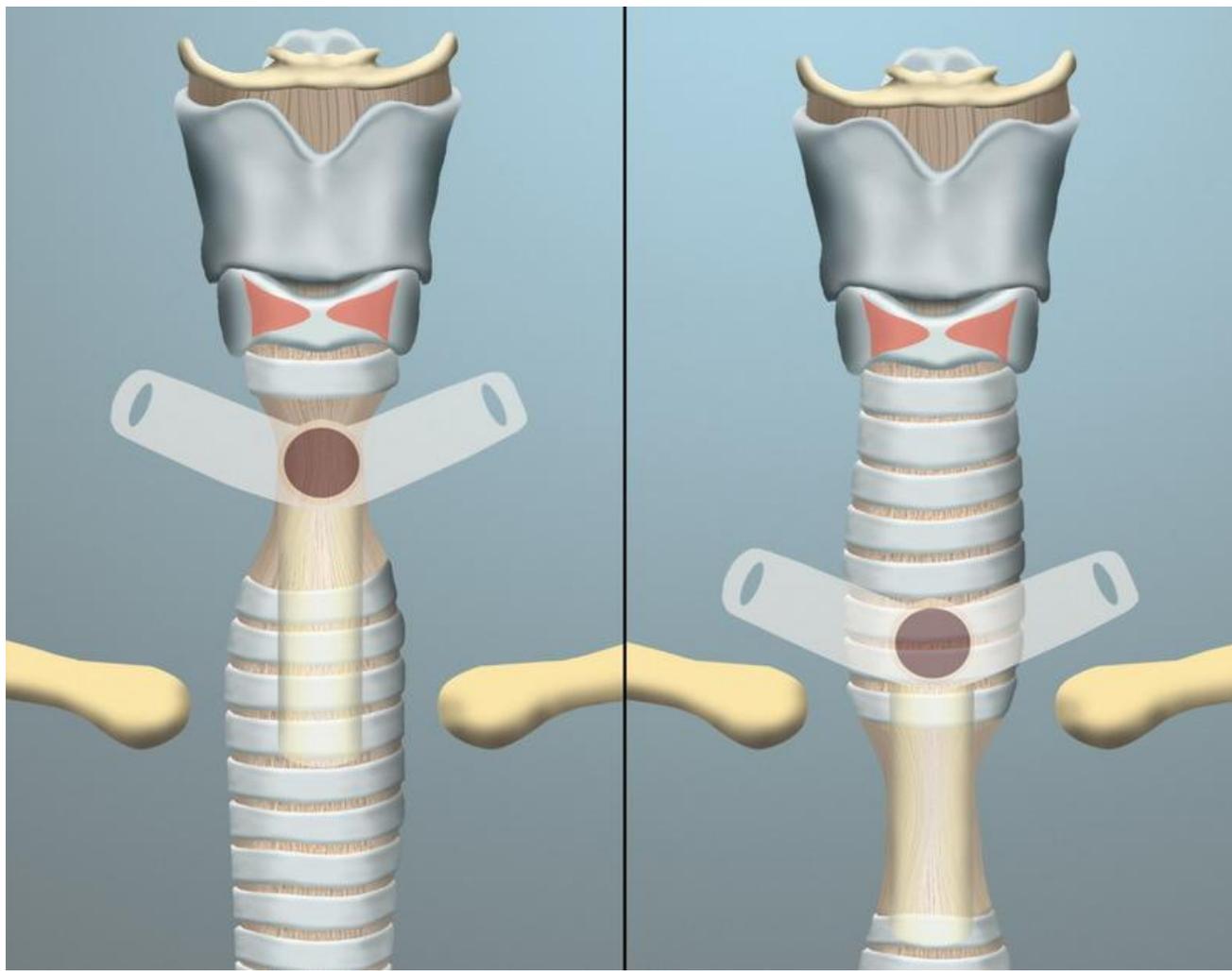
Tracheotomy placement

FOR INCIPIENT LTS



Tracheotomy placement

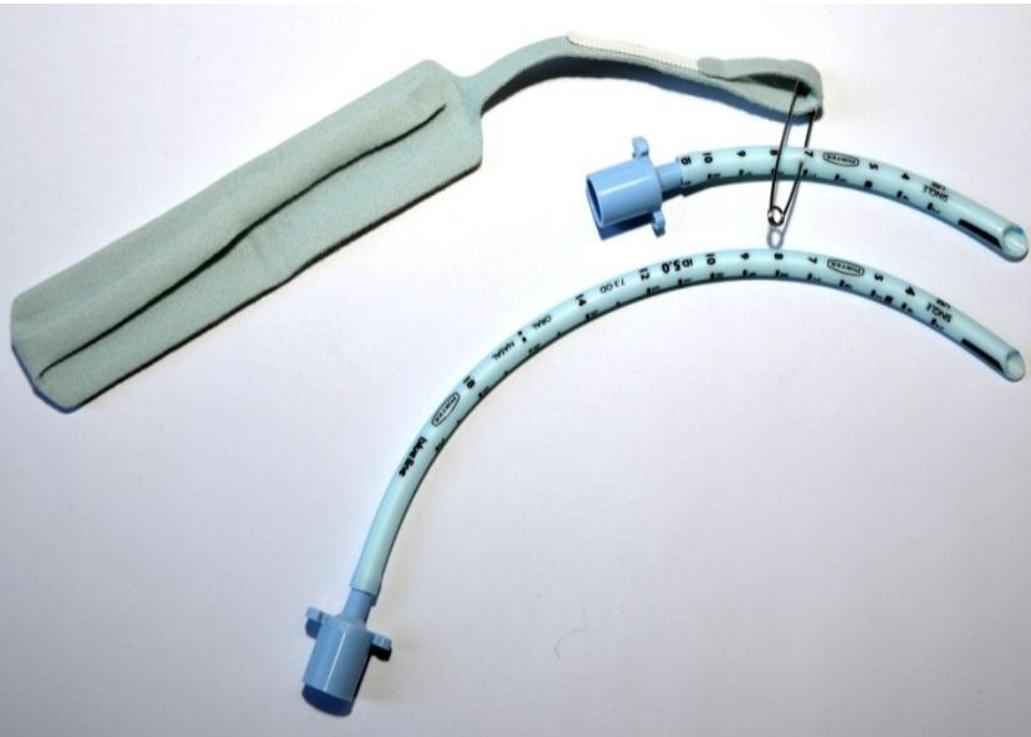
FOR TRACHEAL STENOSIS



cervical stenosis

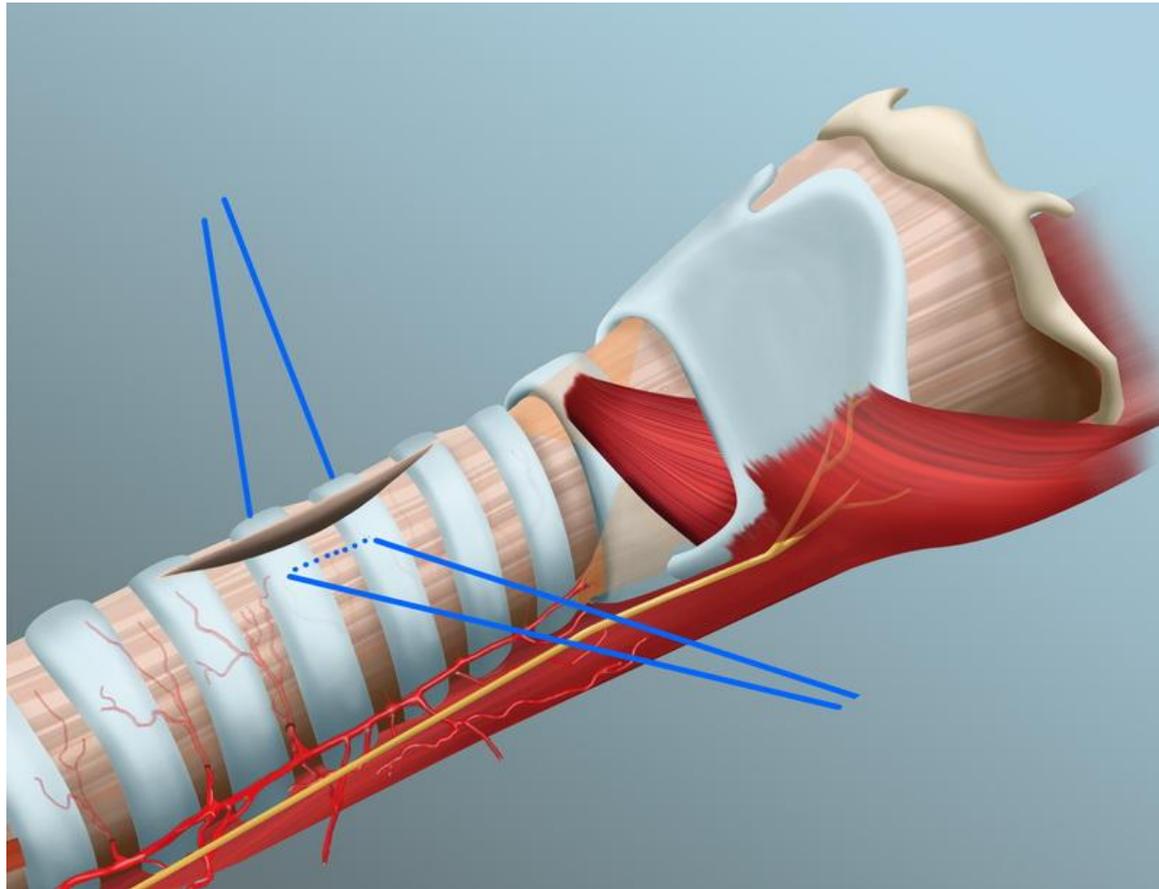
thoracic stenosis

MODIFIED PORTEX BLUE LINE TUBE



- Trans tube flexible bronchoscopic control to avoid distal airway trauma
- Distal tracheal stenting

ANGLO-SAXON OPERATIVE TECHNIQUE

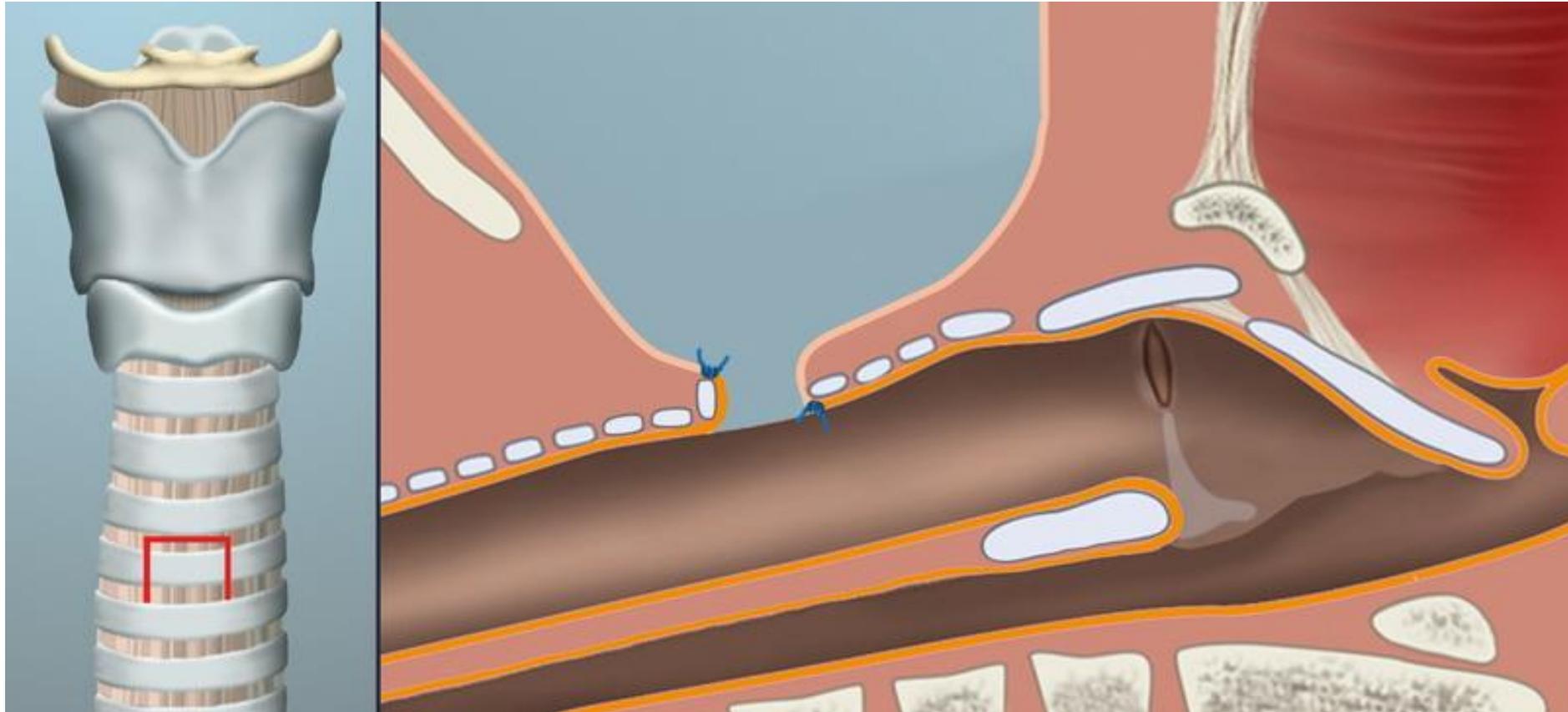


OPERATIVE TECHNIQUE Lausanne

- Under general anesthesia
- ET tube or rigid bronchoscope or laryngeal mask
- Incision of **ONLY ONE tracheal ring**
- Resection of **subcutaneous fat**
- **Resorbable skin sutures** around stoma opening
> mature stoma tract
- Cannula used to calibrate tracheal opening

! CREATE A MATURE STOMA TRACT !

OPERATIVE TECHNIQUE



front view

- > Single ring Bjork's flap
- > Width should not be more than the length
- > stomal size calibrated as per cannula size

lateral view

ADVANTAGES

- No risk of **false passage** during recannulation
- Prevention of air and mucus leaks
 - > **no subcutaneous emphysema**
under positive pressure ventilation
- Less **suprastomal collapse and granuloma**

EARLY COMPLICATIONS

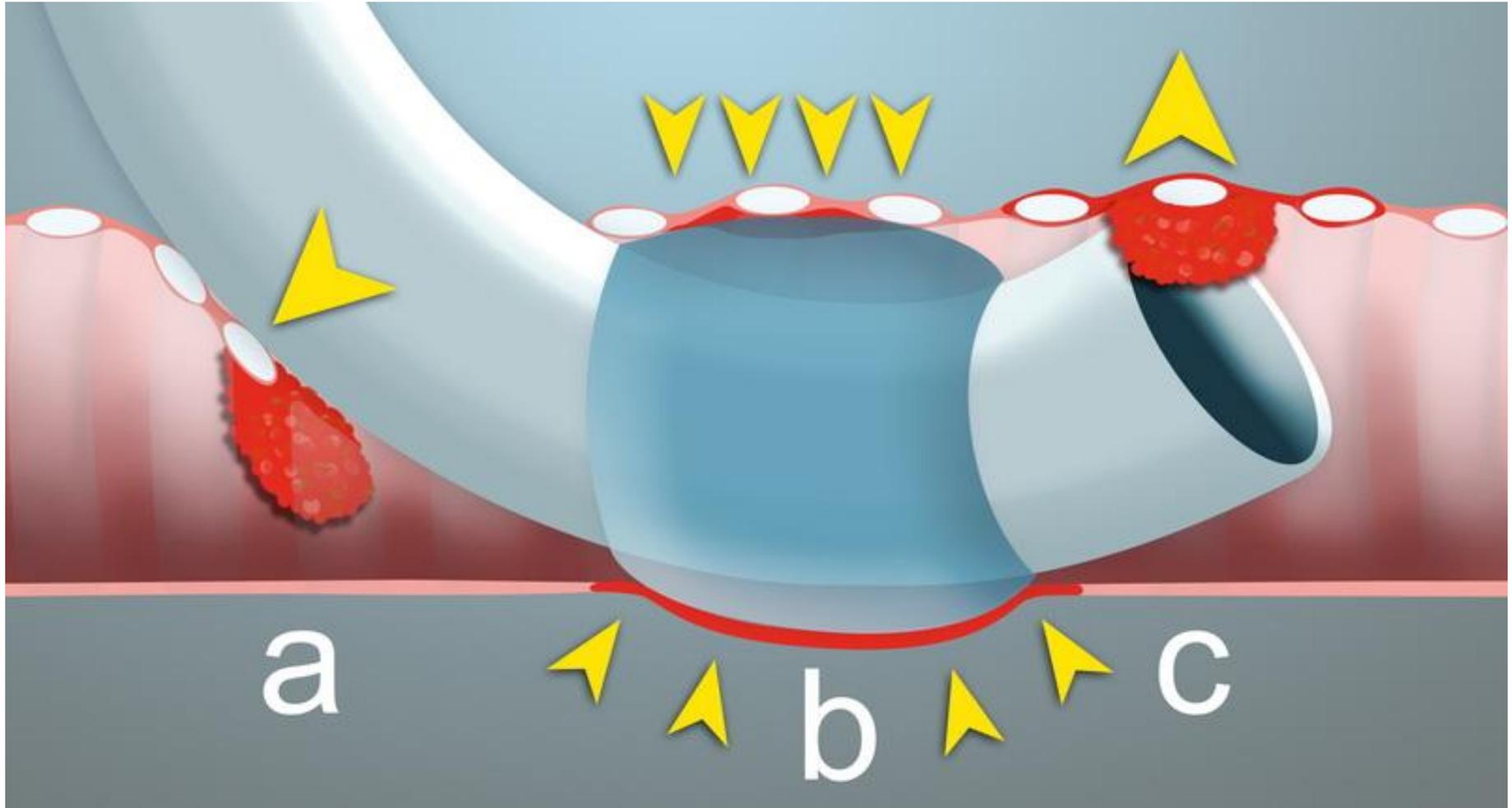
- Within the first postoperative week
 - > hemorrhage
 - > pneumomediastinum
 - > pneumothorax
 - > local infection
 - > accidental decannulation
 - > mucous plugging of cannula

! TECHNICAL ERRORS or POOR TRACH. CARE !

LATE LOCAL COMPLICATIONS

- Suprastomal collapse and granuloma
- Cannula tip granuloma or stenosis
- Granulation tissue along stoma tract
- Double lumen stoma tract
- Lower airway infection, pneumonia
- Accidental decannulation
- Plugged tracheostomy cannula
- Localized tracheomalacia

CANNULA-RELATED STENOSIS



EXAMPLES



Suprastomal collapse + granuloma



A-frame tracheal deformity



Cannula tip granuloma



Cannula tip stenosis

- **Poor tracheostomy care**

- > removal of infected granulation tissue
 - bipolar coagulation/biopsy forceps/scissors

- > Ciproxin HC ear drops/ nebulisations

- > gentamycin-corticosteroid ointment

} 3 x /d

- > change of tracheostomy cannula

- **Lower airway infection**

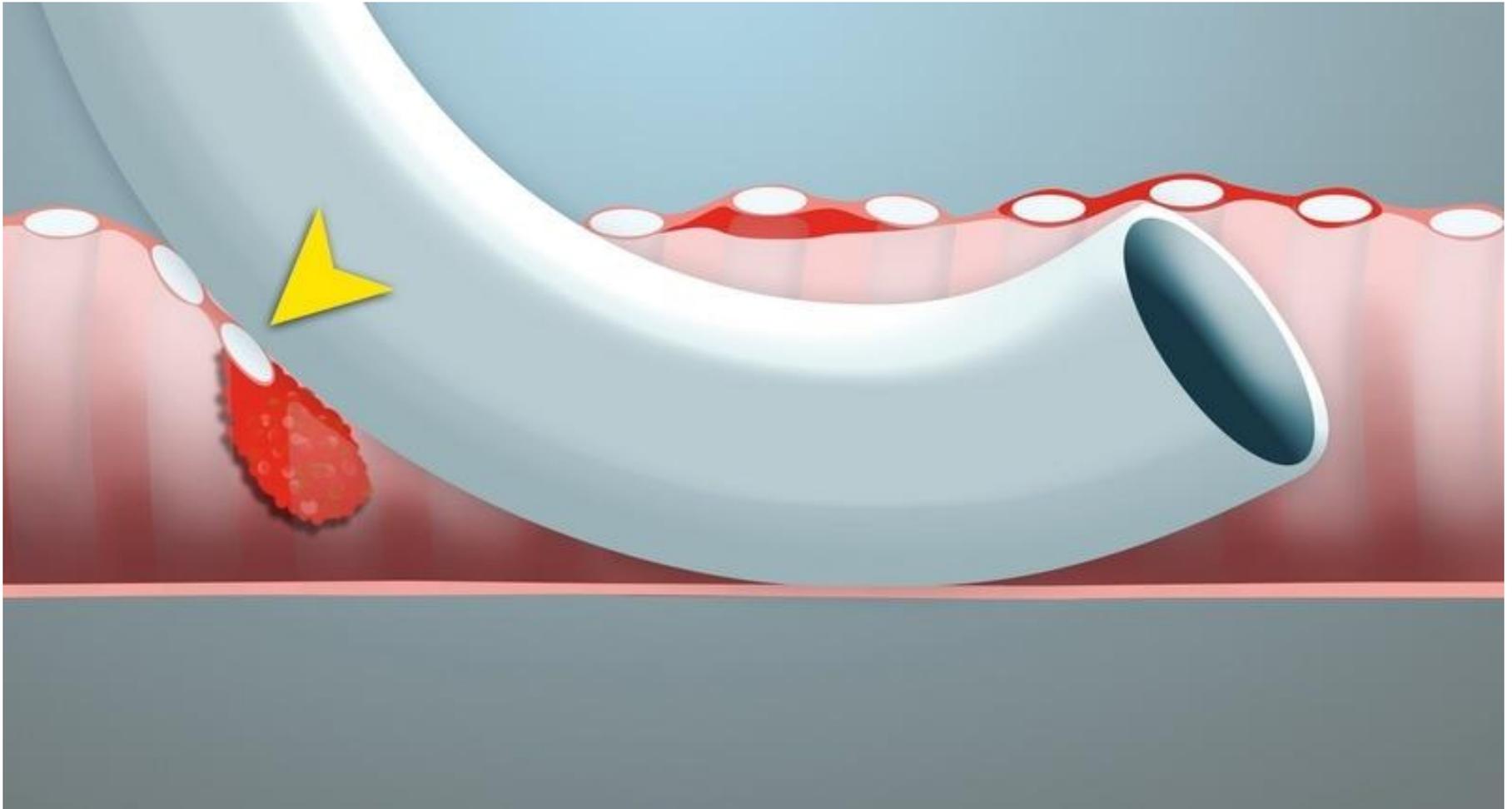
- > bacteriological aspirate

- > proper systemic antibiotics

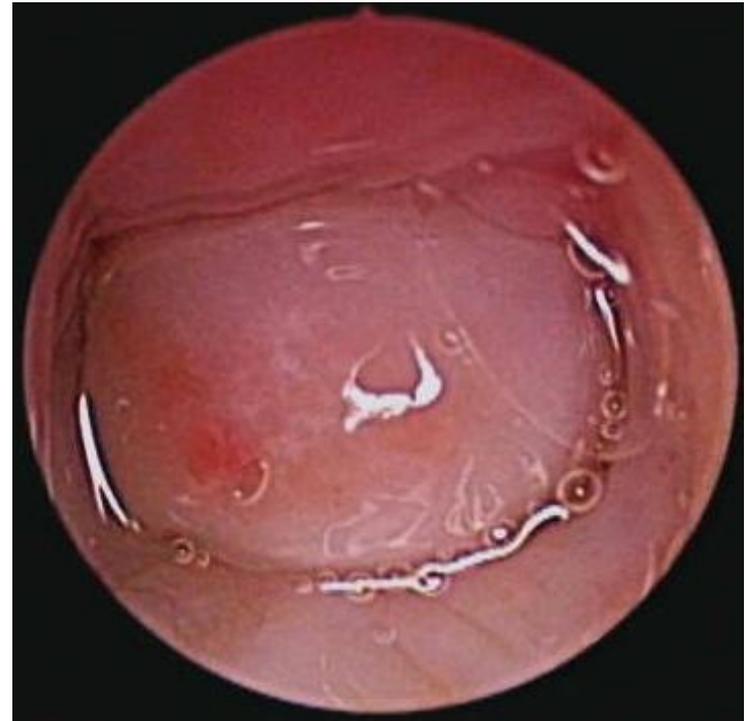
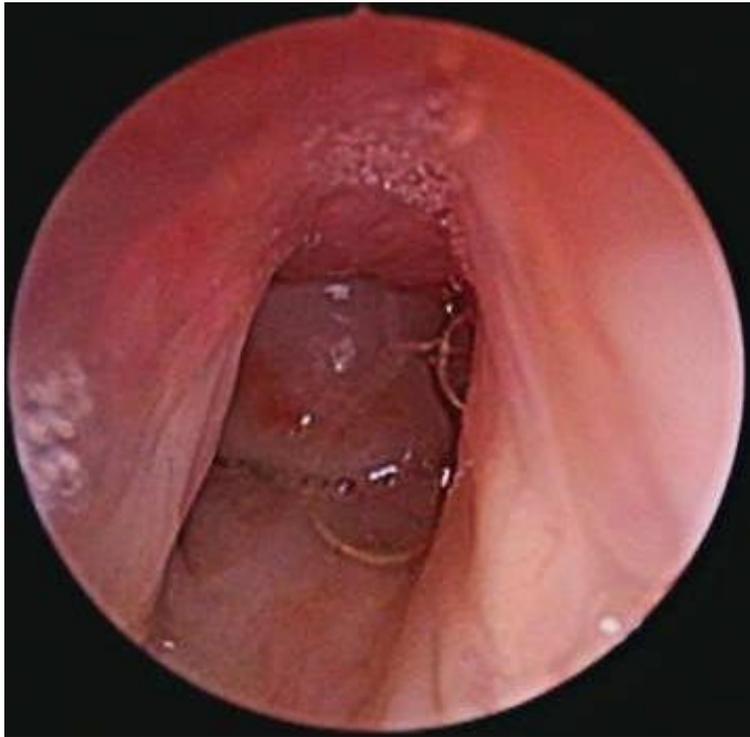
SUPRASTOMAL COLLAPSE and GRANULOMA

- **Frequently seen in infants and small children**
 - > asymptomatic until capping trials or decannulation
- **CAUSES**
 - soft pliable cartilages in children
 - temporary arrest of tracheal growth
 - convexity of tracheostomy cannula
 - infection
- **Partially avoidable if**
 - > skin sutured around tracheostoma opening
 - > good tracheostomy care

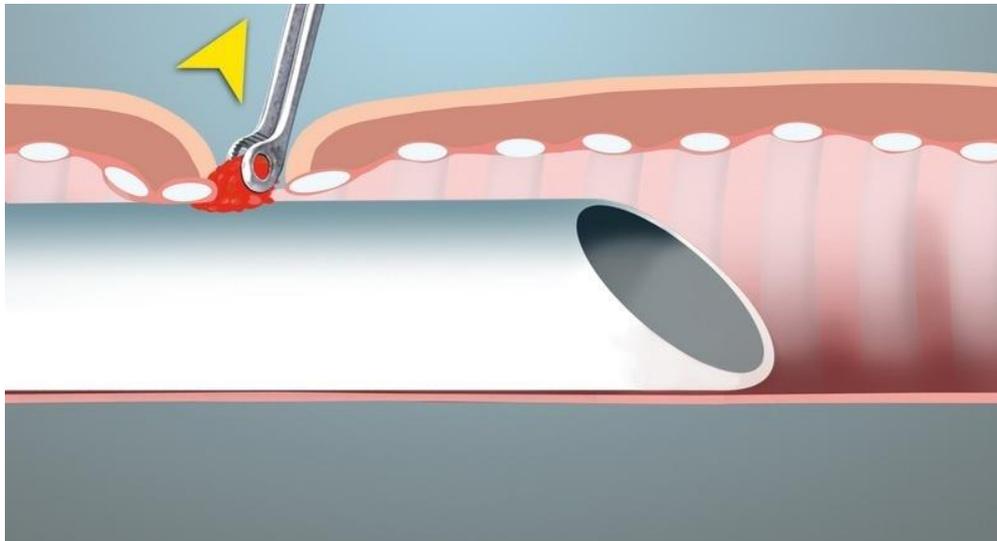
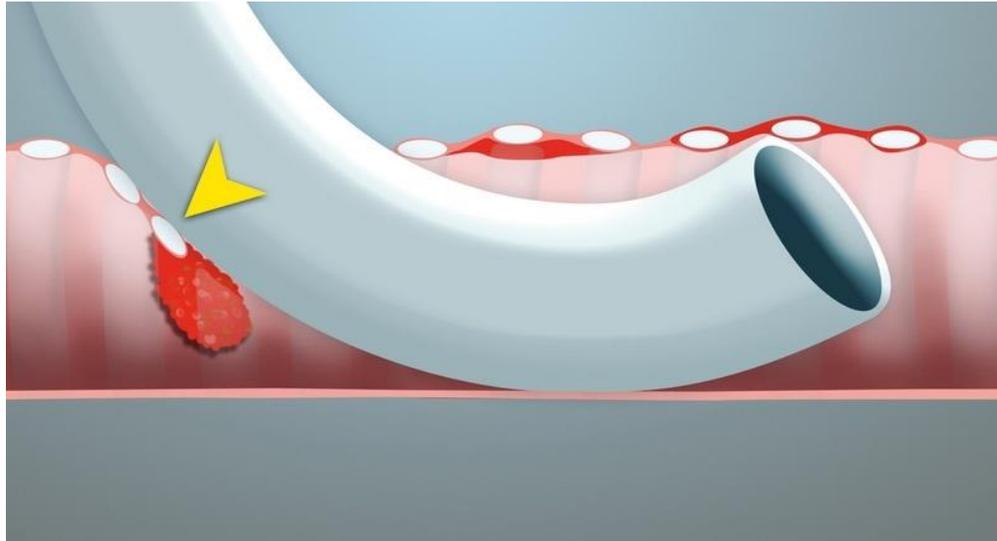
SUPRASTOMAL COLLAPSE and GRANULOMA

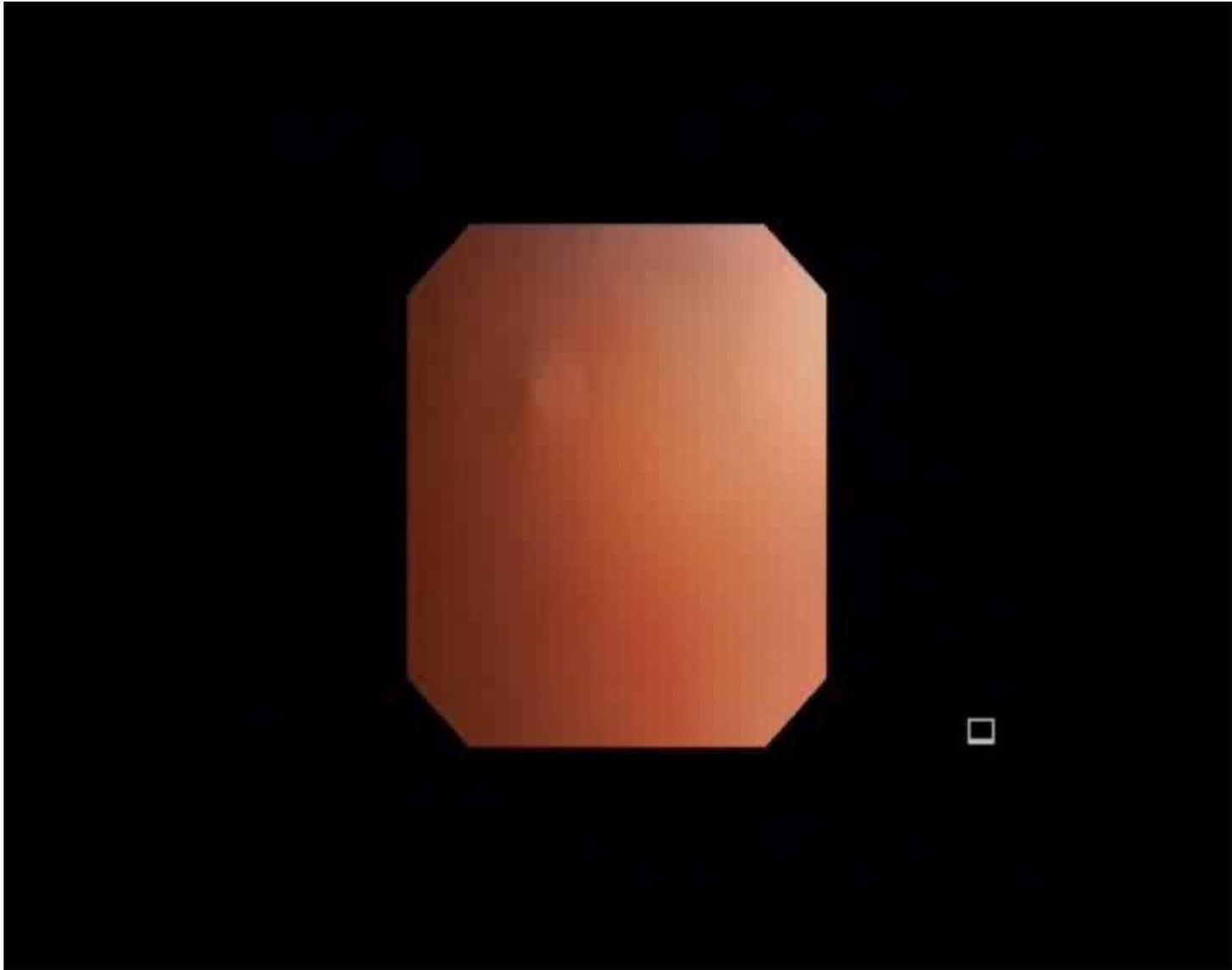


ENDOSCOPIC FINDINGS



EFFECT OF ET INTUBATION







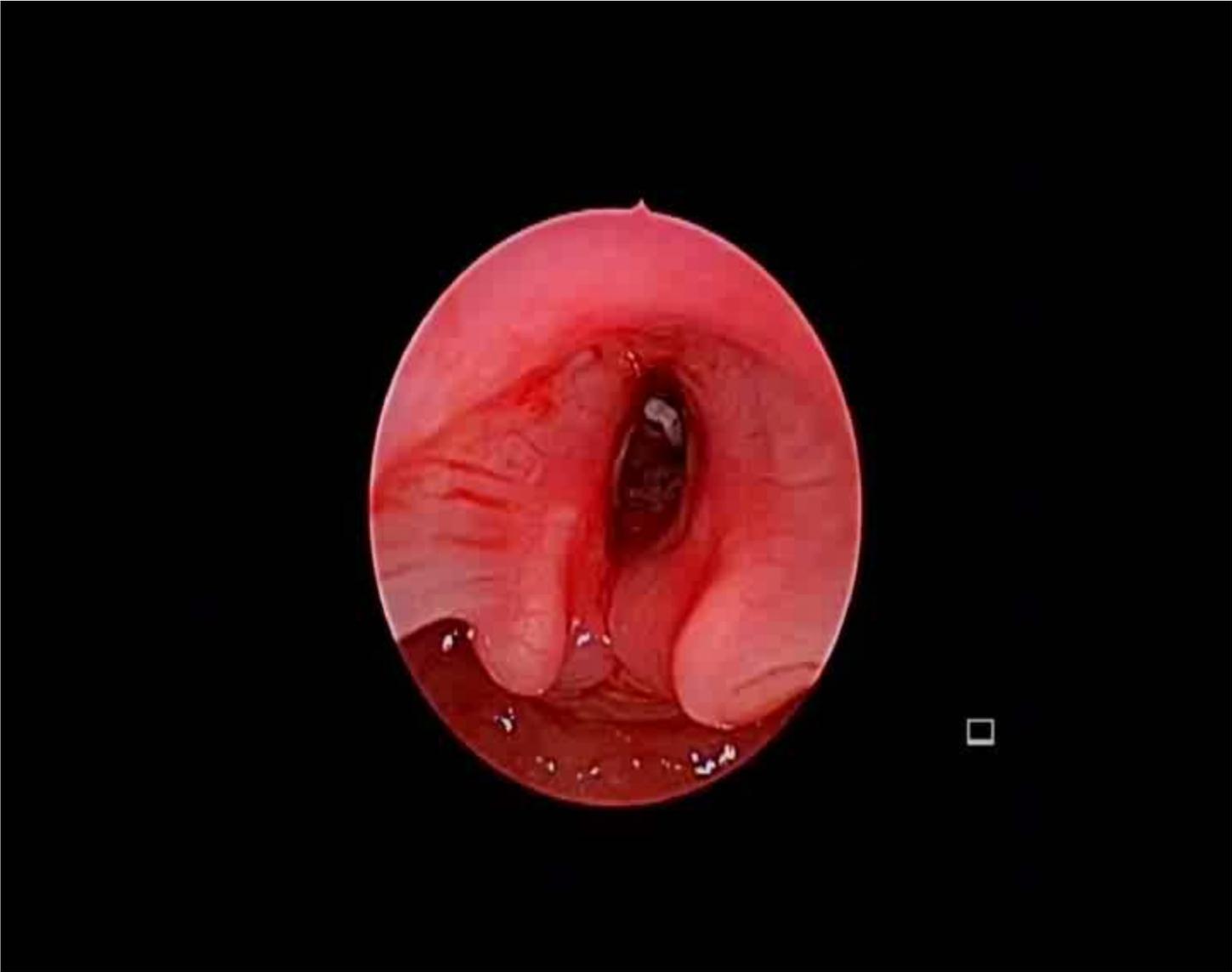
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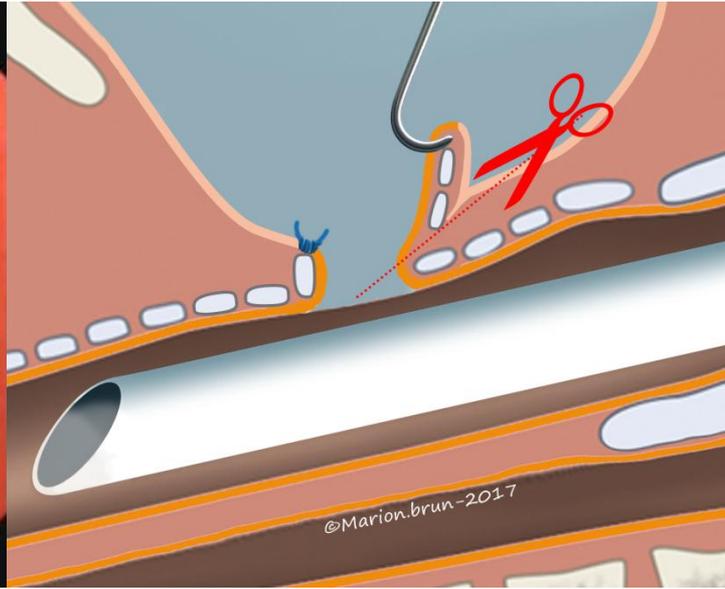




Suprastomal collapse

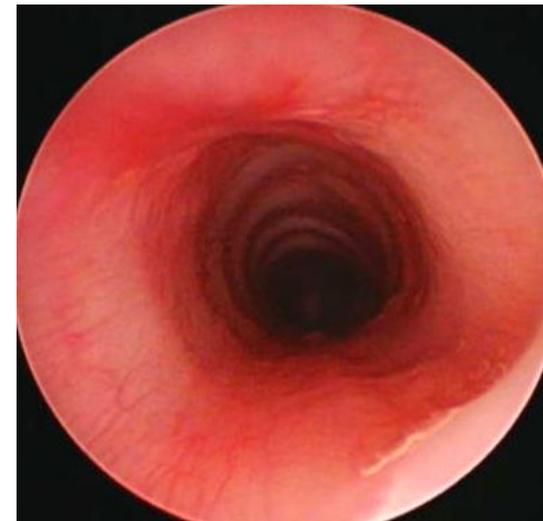


Pre op



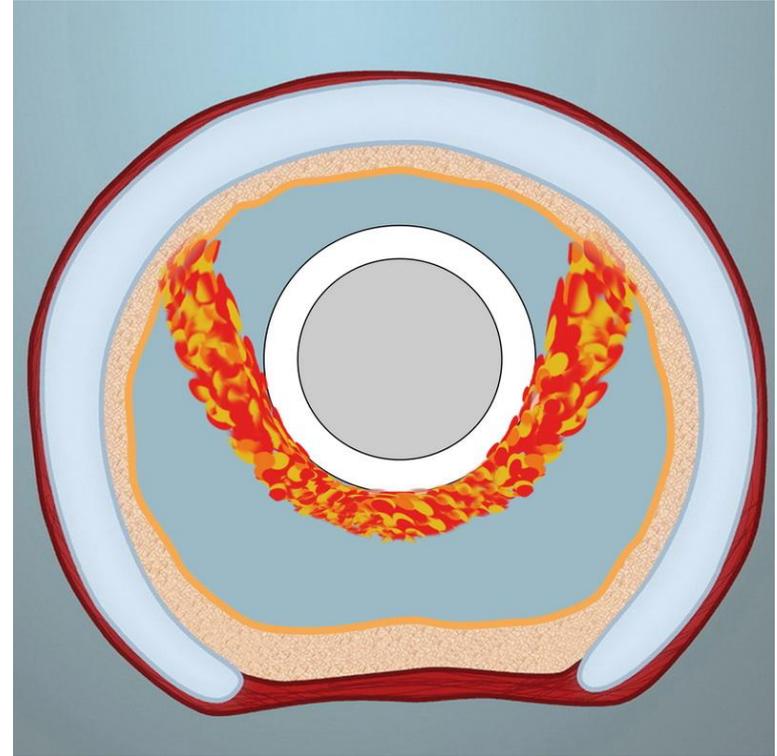
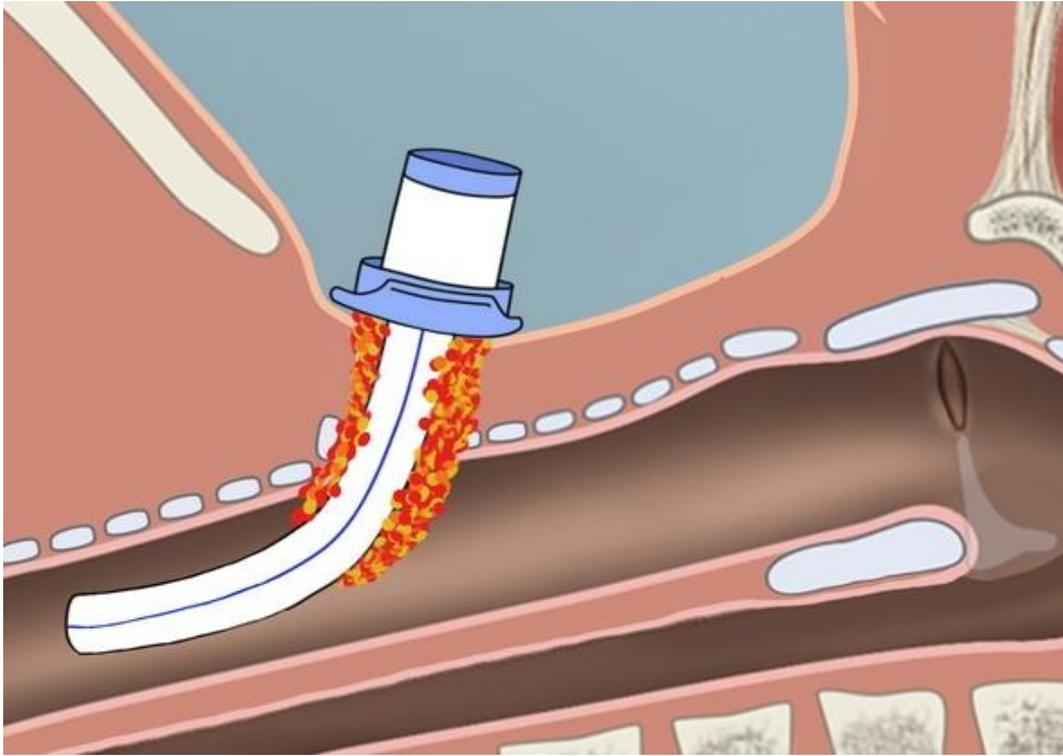
Immediate post op

> 3 months



Tracheostomy

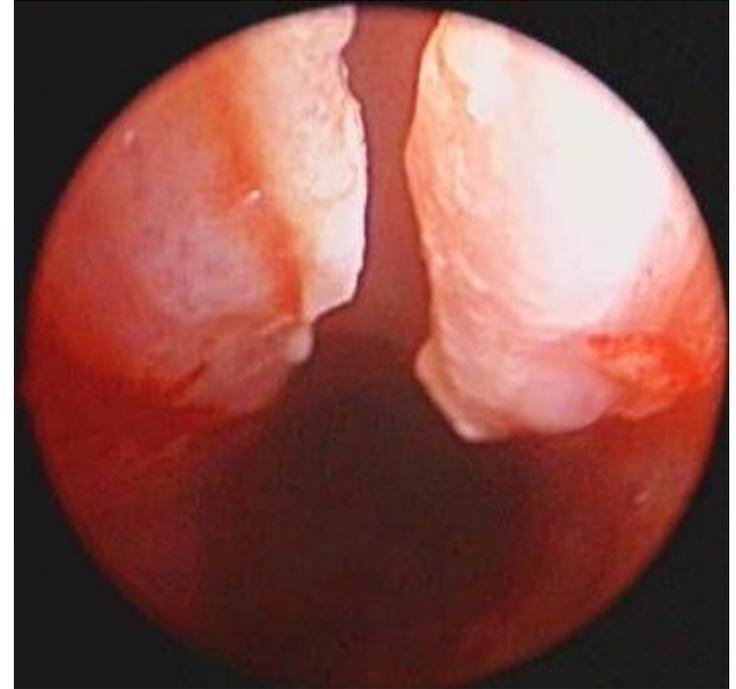
DOUBLE TRACHEAL LUMEN



DOUBLE TRACHEAL LUMEN



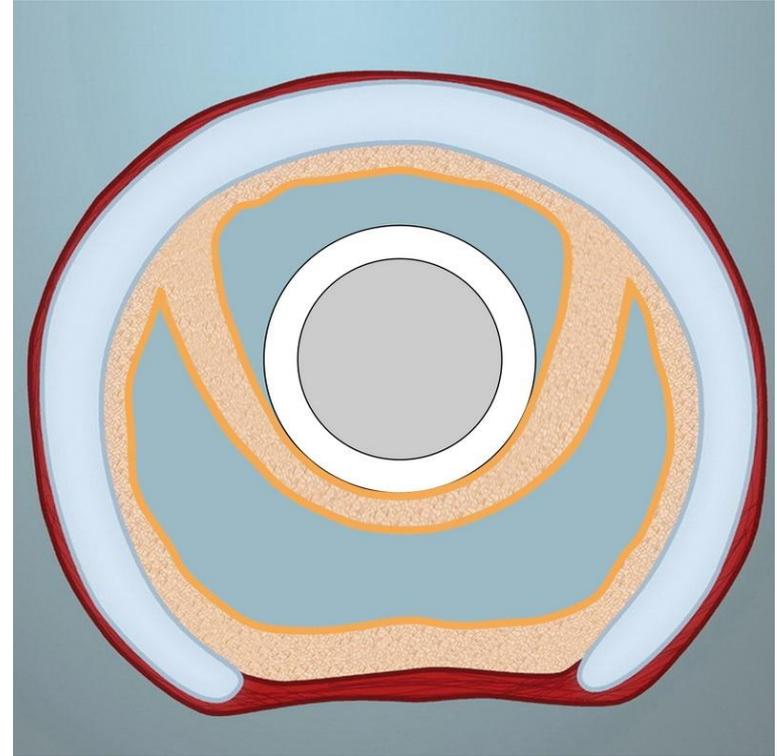
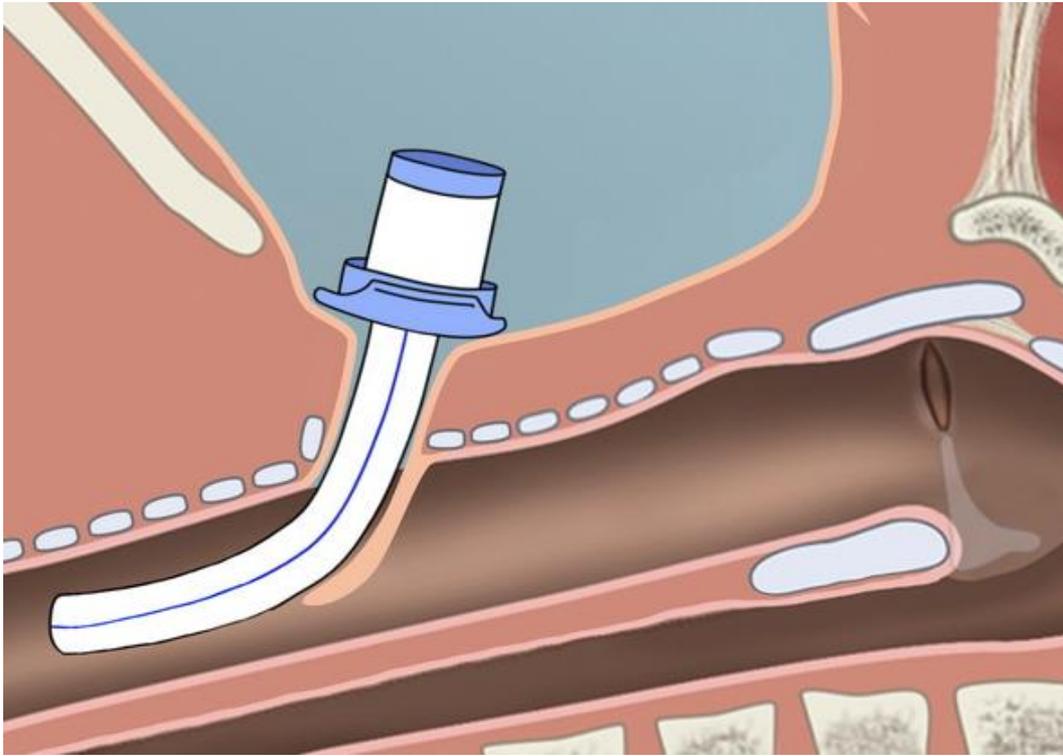
Granulation tissue arising from lateral aspect of tracheotomy



Granulation tissue about to merge in the midline

Tracheostomy

DOUBLE TRACHEAL LUMEN



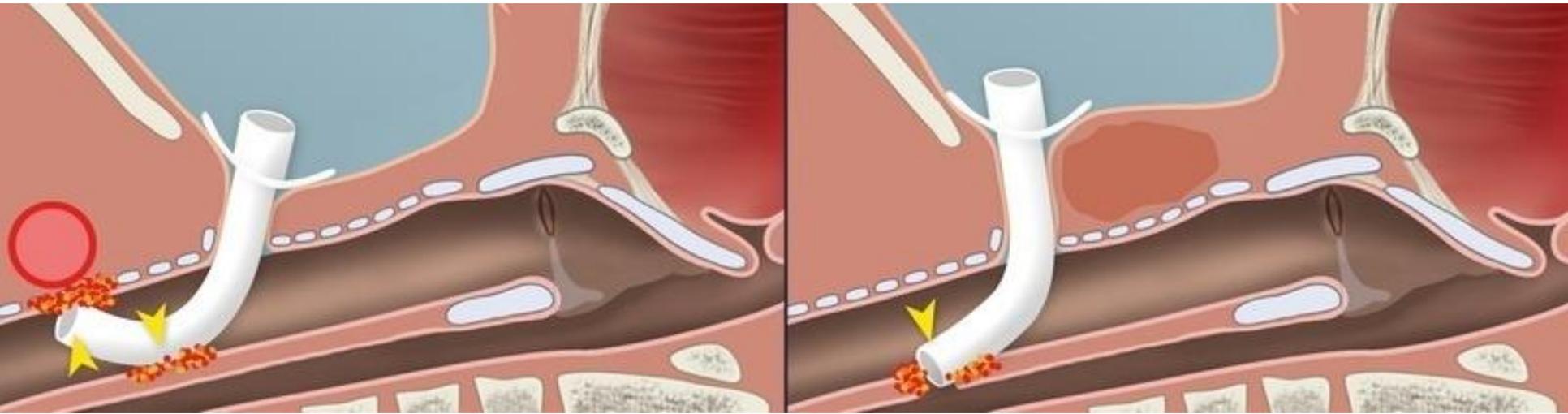
AT THE STAGE OF MATURE CICATRICIAL TISSUE

Tracheostomy

DOUBLE TRACHEAL LUMEN



RARE PEDIATRIC COMPLICATIONS



Tracheo-innominate
artery fistula

PULSATING CANNULA
BLEEDING GRANULATIONS

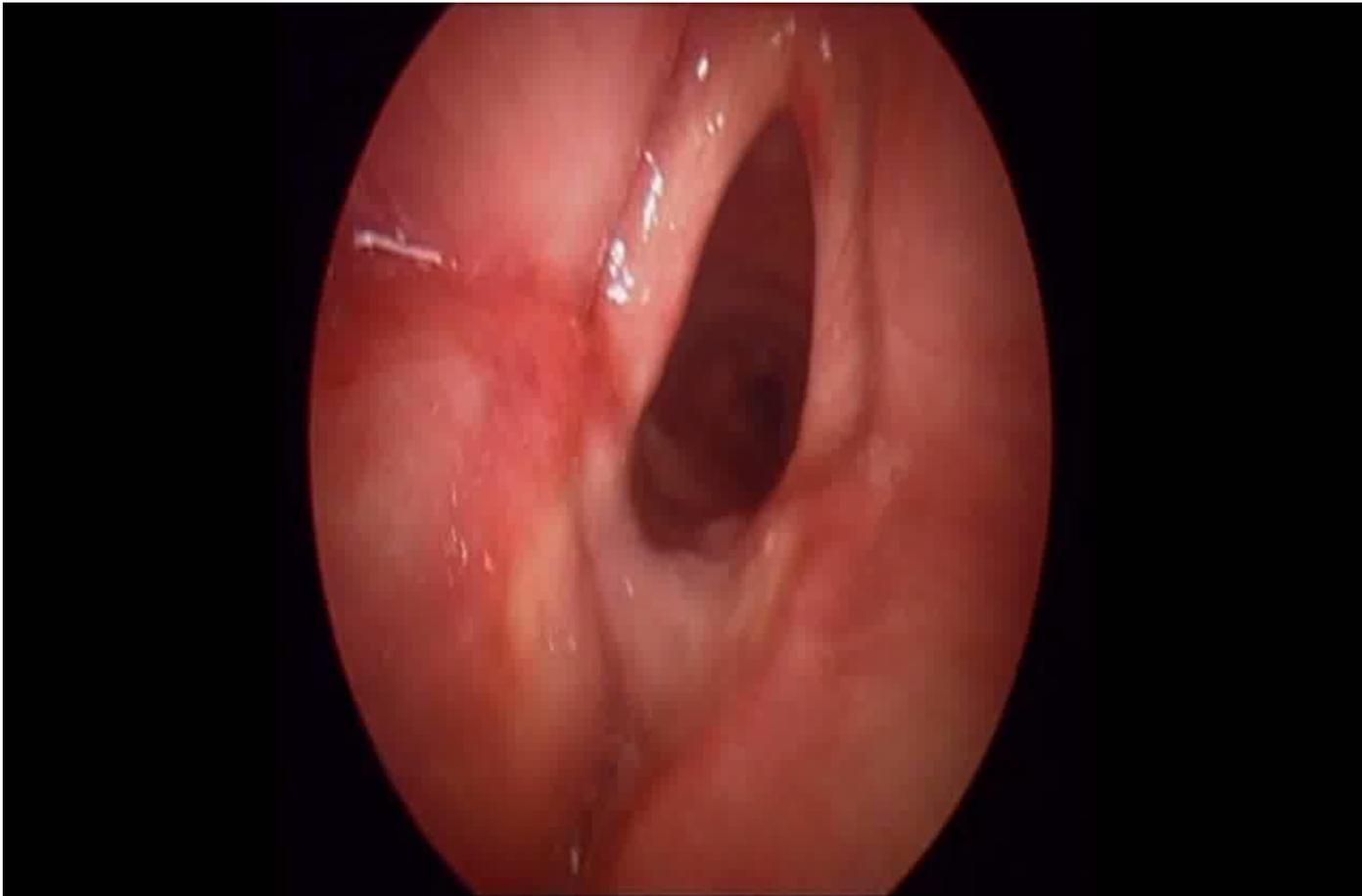
Tracheo-esophageal
fistula

Pre op endoscopy

>Tracheocutaneous fistula

>Stomal malacia

>1.5 cms ETF



POST-DECANNULATION COMPLICATIONS

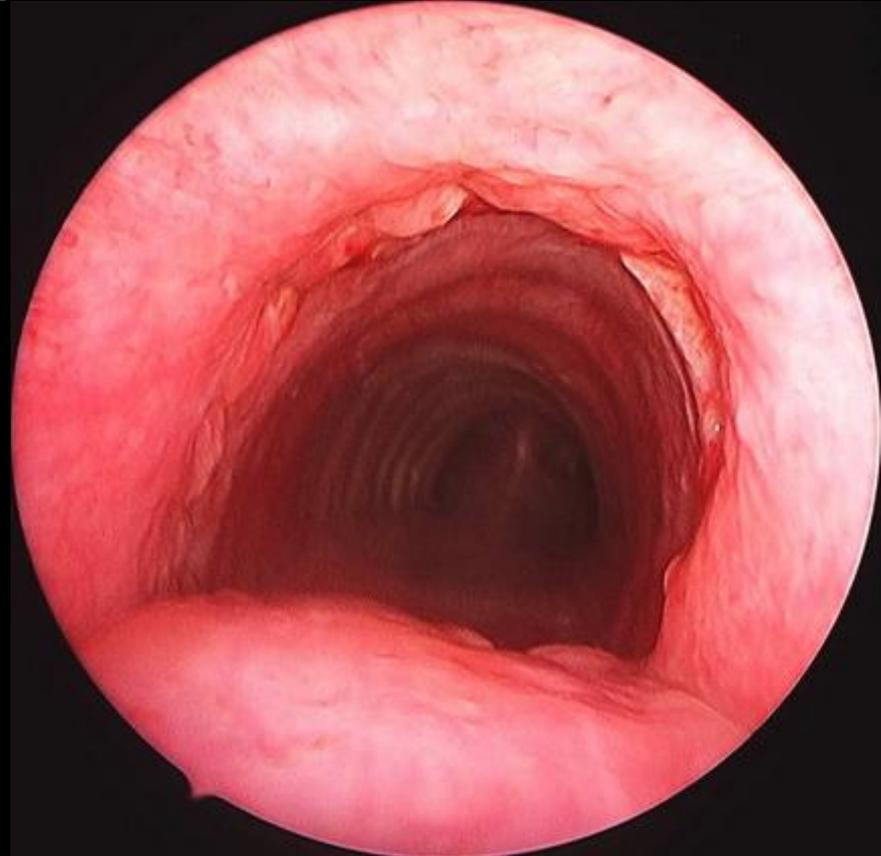
- Localized tracheomalacia /
A-frame deformity /
Suprastomal collapse

- Distal tracheal stenosis

Localized tracheomalacia

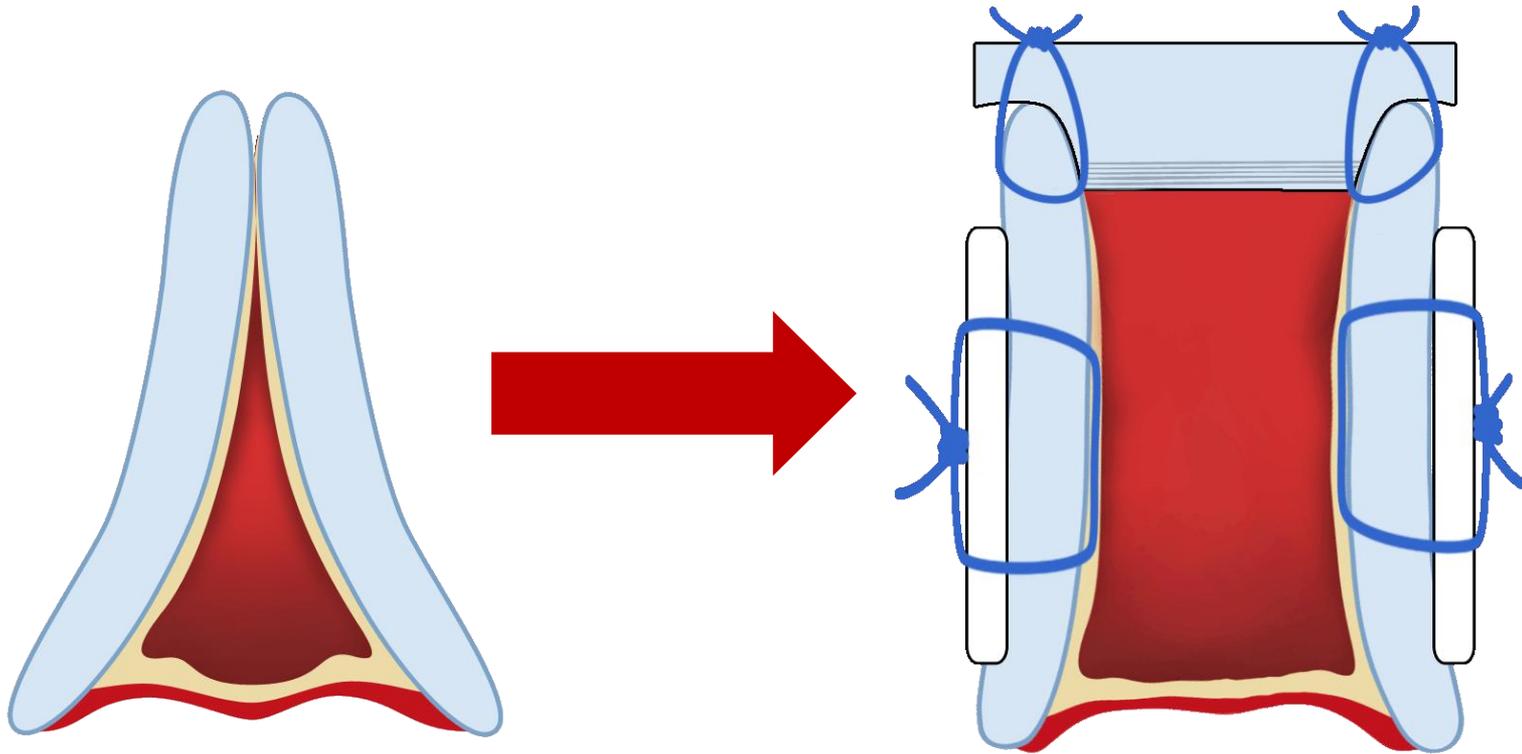


Former tracheostoma
dynamic airway exam



10 days post-resection
anastomosis

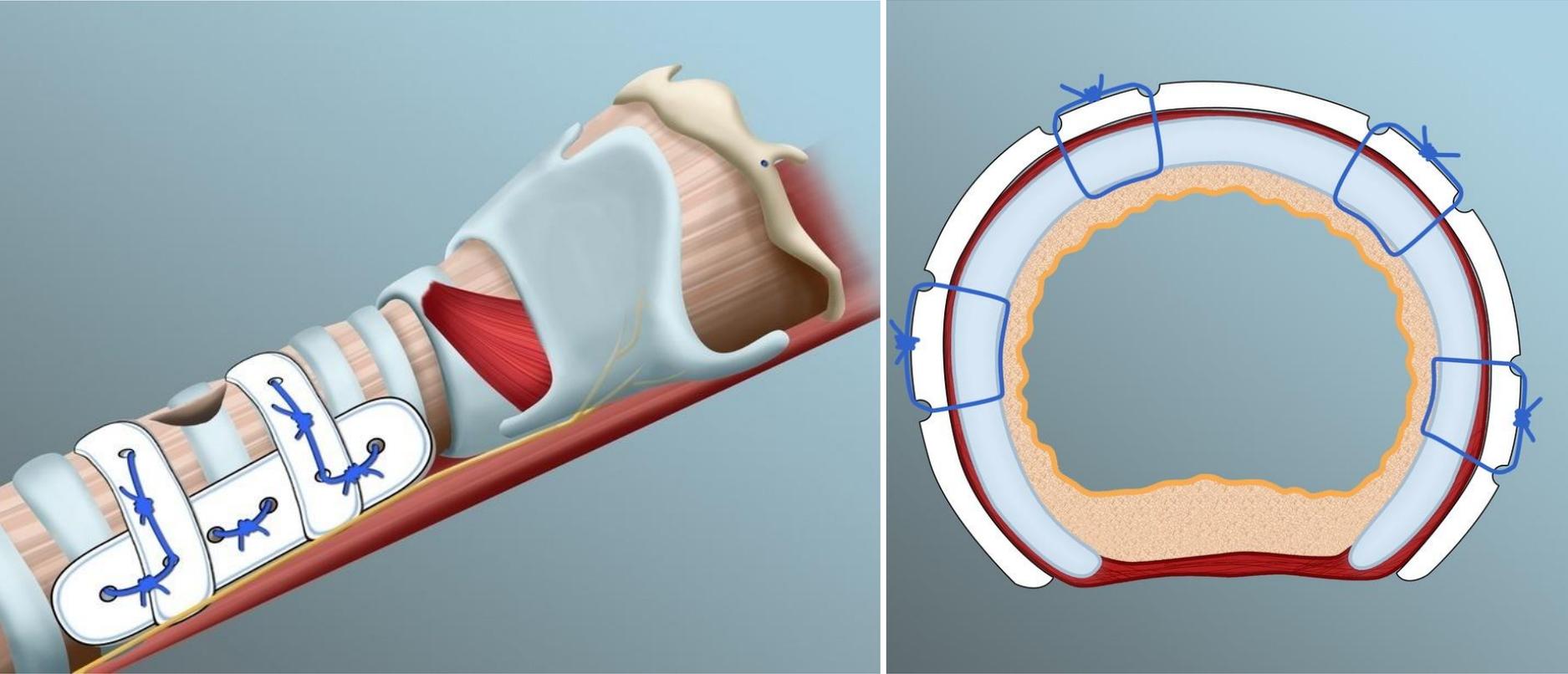
A-FRAME TRACHEAL DEFORMITY



Anterior cartilage graft
± PDS miniplates

! WHEN RESECTION-ANASTOMOSIS IS IMPOSSIBLE !

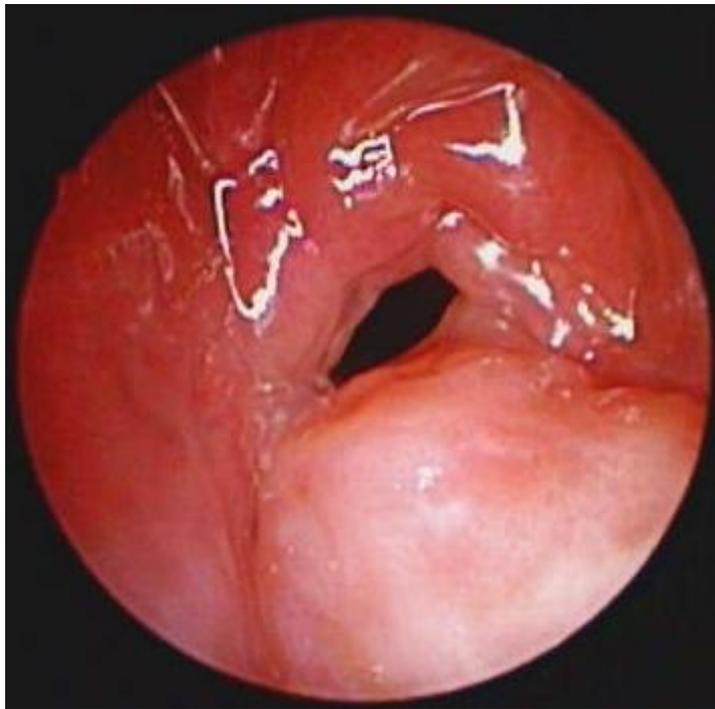
TRACHEAL REINFORCEMENT



Transfixiant 4.0 PDS sutures

TRACHEAL REINFORCEMENT

Preoperative view



Postoperative view



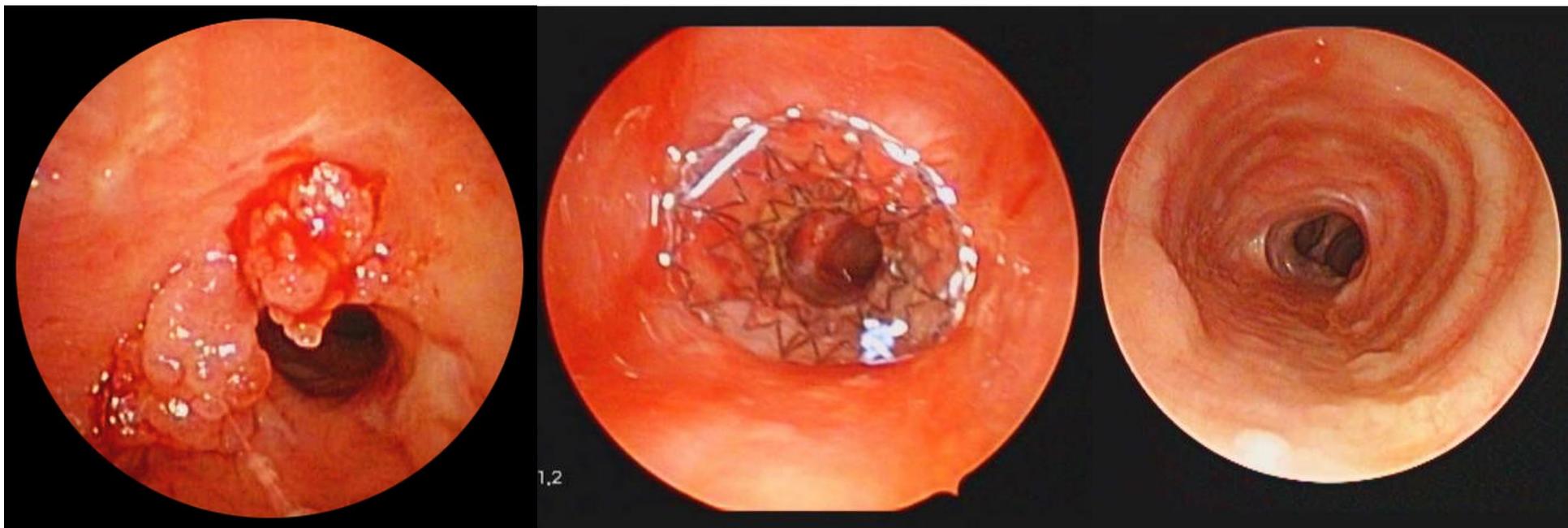
PDS miniplates ± anterior costal cartilage graft

LOWER AIRWAY INFECTION

! A TRACHEOSTOMIZED PATIENT SHOULD ALWAYS HAVE A BACTERIOLOGICAL ASPIRATE UPON ARRIVAL AT THE HOSPITAL !

Distal tracheal stenosis

INTRATHORACIC STENOSIS



Preoperative view

Stenting

Final result

! LASER, DILATATION, SHORT-TERM STENTING !

DISTAL AIRWAY STENTING

- Long cannula bypassing stenosis
- Non-cuffed endotracheal tube passed through tracheostoma
- Temporary short-term stenting



! PROPER TUBE POSITIONING MAY BE DIFFICULT !

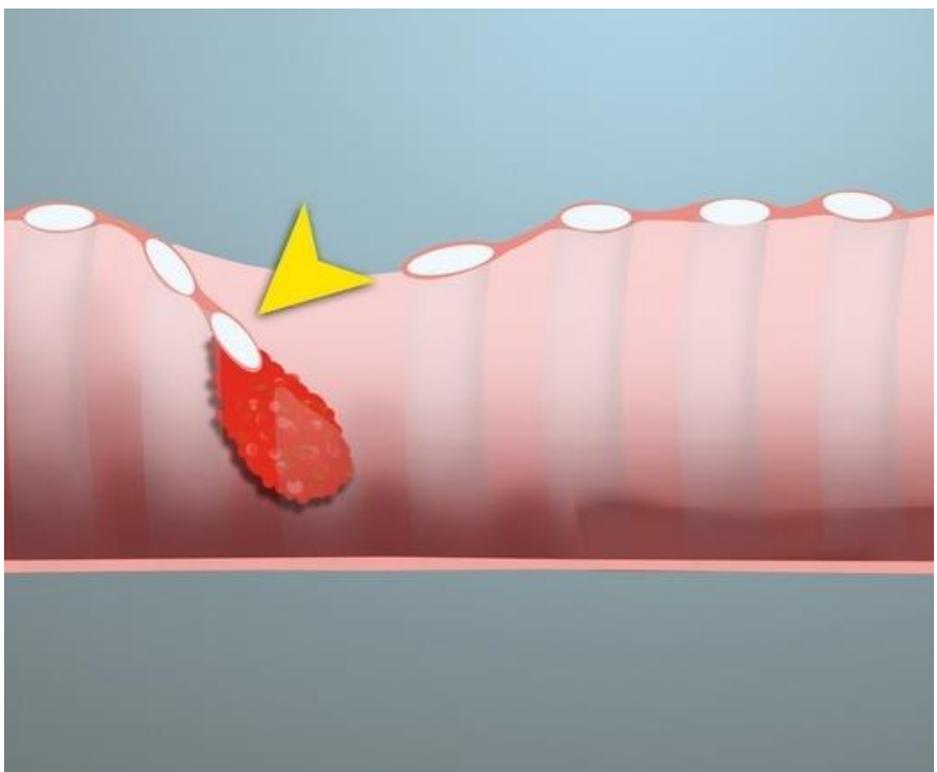
**—
NEED FOR FIBEROPTIC CONTROL !**

- Only when the **initial cause to do tracheostomy has resolved / been corrected**
- **Thorough airway evaluation** (flexible / rigid)
 - > under spontaneous respiration
 - > with temporary removal of cannula
- **Down-sizing** of tracheostomy tube
- Successful **capping trials** of tracheostomy tube
 - > during the day
 - > **Polysomnography** (OSA-related obstruction)

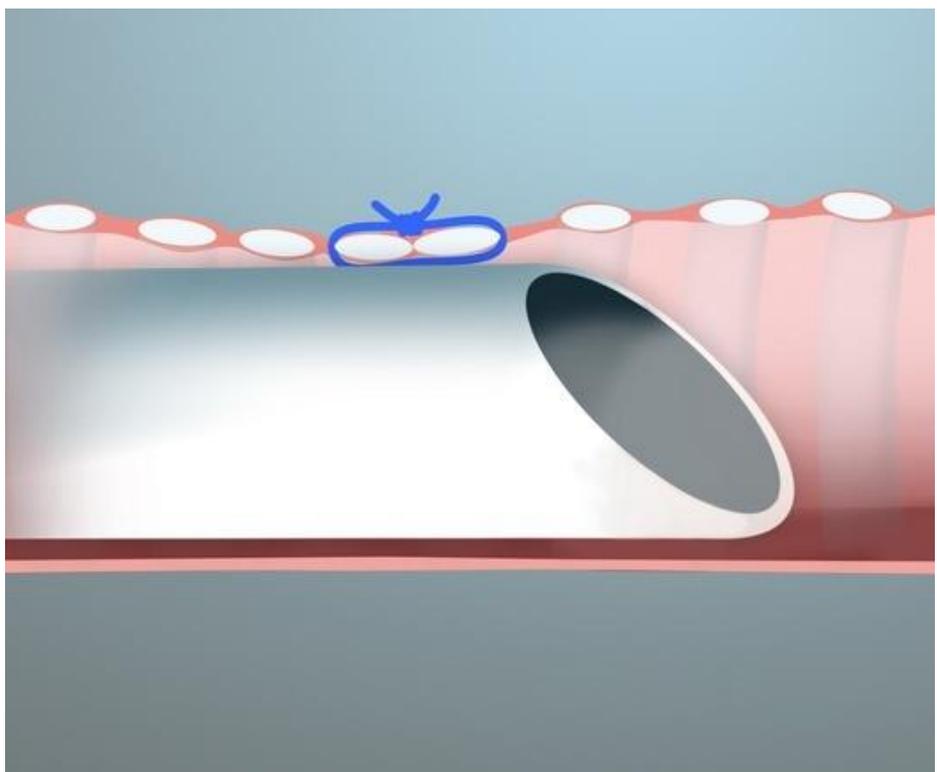
SURGICAL CLOSURE

- After successful airway reconstruction
 - > improves local situation at stoma site
 - > avoids tracheocutaneous fistula
 - > eliminates unsightly scar
- **Transoral intubation**
 - > ET tube passed beyond tracheostoma
 - > removal of granuloma pushed inside the tracheostomy opening
- **Removal of ellipse of skin around stoma**
- **Excision of skin pit down to trachea**
- Closure with stitches placed in **cranio-caudal axis**

SURGICAL CLOSURE

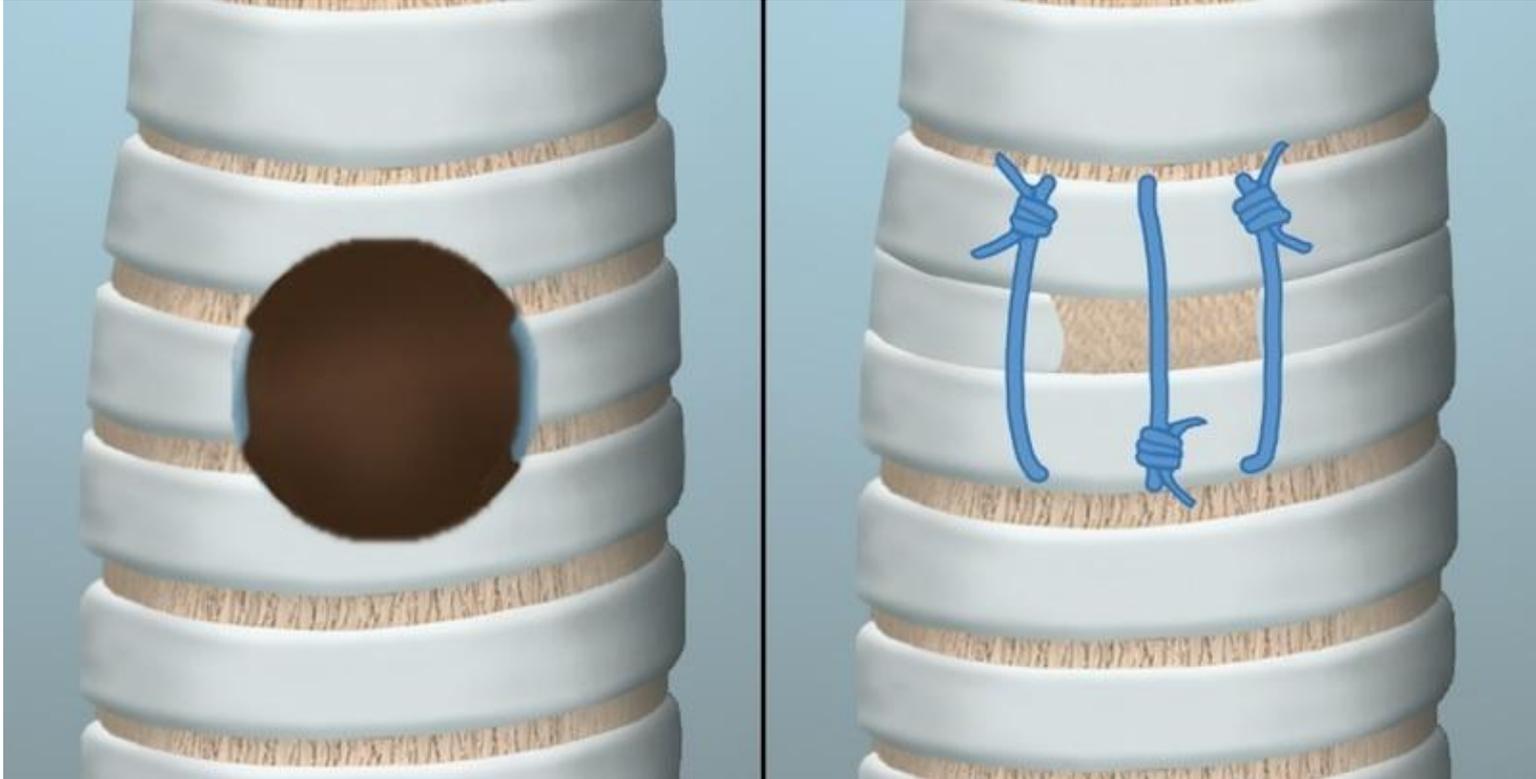


Suprastomal collapse



Removal of granuloma + closure

SURGICAL CLOSURE



Complete resection
of cutaneous stoma

Stitches in cranio-caudal axis
*Restores a steady Roman vault
at the stoma site*



- **Current indications**
 - > upper airway obstruction
 - > prolonged ventilatory support
 - > pulmonary toilet
- Great inter-institutional **variations in indications**
- **Tracheotomy location**
 - > dependent on indication

- **Mortality** ~ 1-3%
 - > accidental decannulation
 - > plugging of tracheostomy tube
- **Complications (under-reported)**
 - > early
 - > late
 - > post-decannulation
- **Tracheotomy management at home**
 - > full parental training
 - > caregiver support

MANAGEMENT OF SUBGLOTTIC STENOSIS

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**Centre hospitalier
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Endoscopic vs Open & *COMBINED APPROACHES*

1. CONGENITAL

- Cricoid malformation
- Web

2. ACQUIRED

- Fresh incipient post intubation stenosis
- Established stenosis



...Complimenting each other, & for result optimisation
AIRWAY SURGEON MUST BE TRAINED IN BOTH



MODIFIED MYER-COTTON AIRWAY GRADING SYSTEM

| Myer-Cotton grade | | Isolated SGS | Isolated SGS + comorbidities | SGS + glottic involvement | SGS + glottic involvement + comorbidities |
|-------------------|-----------|--------------|--|-------------------------------------|---|
| | | a | b | c | d |
| I | 0% - 50% | I a | I b | I c | I d |
| II | 51% - 70% | II a | II b | II c | II d |
| III | 71% - 99% | III a | III b | III c | III d |
| IV | No lumen | IV a | IV b | IV c | IV d |

PARAMETERS INFLUENCING OUTCOME

- STENOSIS
 - > Fresh, incipient vs mature, cicatricial LTS
 - > Low grade vs high grade LTS
 - > Short vs long stenosis
 - > Subglottic vs glotto-subglottic vs transglottic LTS
 - > Pan-mural vs purely intrinsic stenosis
 - > Malacic vs non-malacic stenosis
- PATIENT
 - > Infants vs children vs adolescents
 - > Secondary airway lesions
 - > comorbidities, congenital anomalies

PRECISE PREOPERATIVE ASSESSMENT IS CRITICAL

ENDOSCOPIC TREATMENTS

INDICATIONS

- > Post-intubation stenosis

- > Select group of cicatricial stenoses
 - Grade I - III acquired SGS
 - * Thin diaphragm
 - PGS

- > Adjunct to open surgery/ *result optimisation*
 - dilation
 - (partial) arytenoidectomy
 - glottic or supraglottic webs

CONTRAINDICATIONS

- Congenital stenosis
- Loss of cartilage support
- Vertical scar > 1cm
- Posterior scarring with arytenoid fixation
- Circumferential scarring

Simpson GT. et al.: Ann.Otol.Rhinol.Laryngol.1982



No additional endoscopic treatment

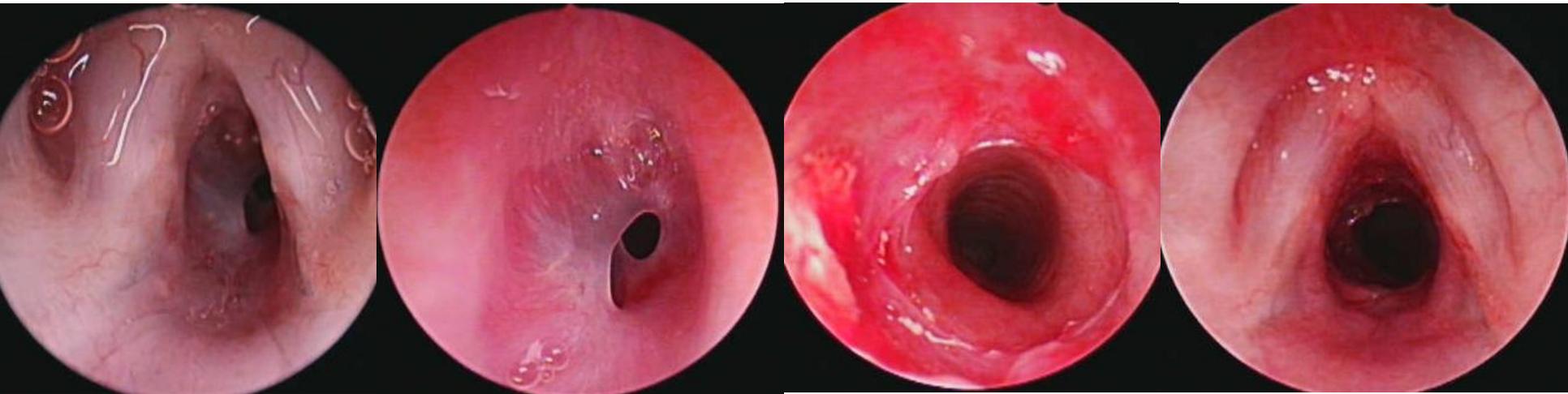
if stenosis recurs to its initial grade after a primary treatment

TYPE OF ENDOSCOPIC TREATMENTS

- CO₂ laser resection / radial incisions
 - > ultrapulse technology
- Dilatation
 - > tapered bougies or balloons
- Cricoid split + balloon dilatation
- CO₂ laser + dilatation + stent
- Mitomycin-C : 2 mg/ml topically

ENDOSCOPIC TREATMENT

Incipient, diaphragm- like SGS



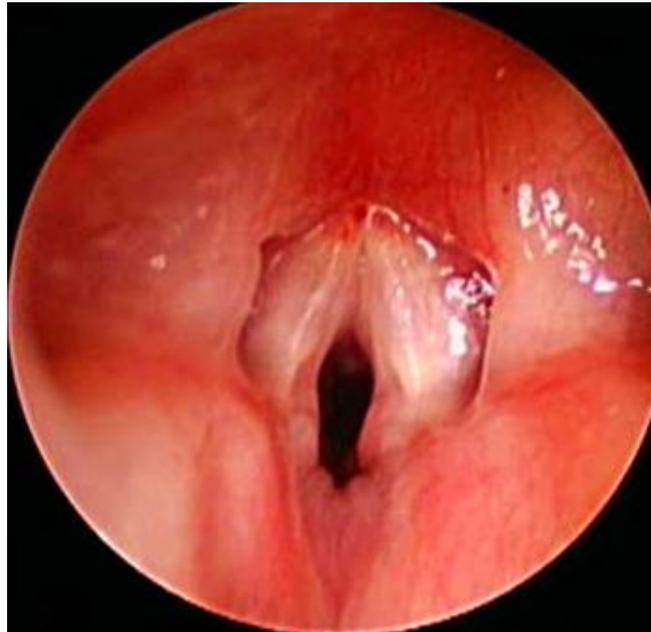
6 weeks

Cardiac surgery on d 18
Multiple extubation failures
CPAP 24h since 5 days

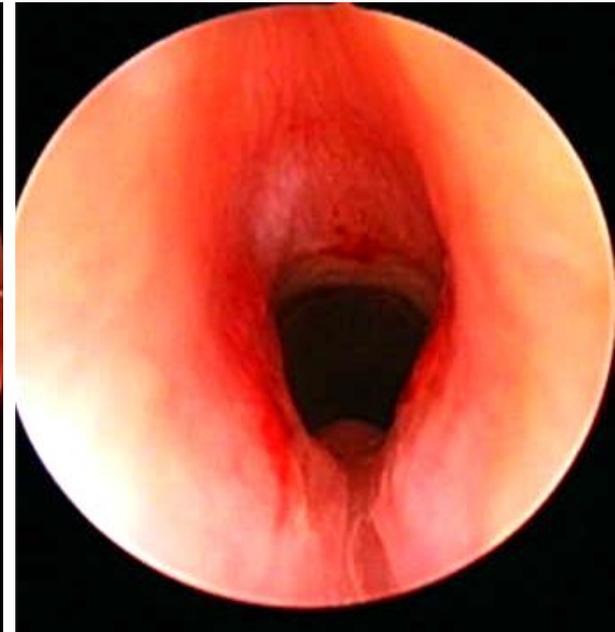
EVOLUTION / MANAGEMENT OF MIXED STENOSIS



Pre op

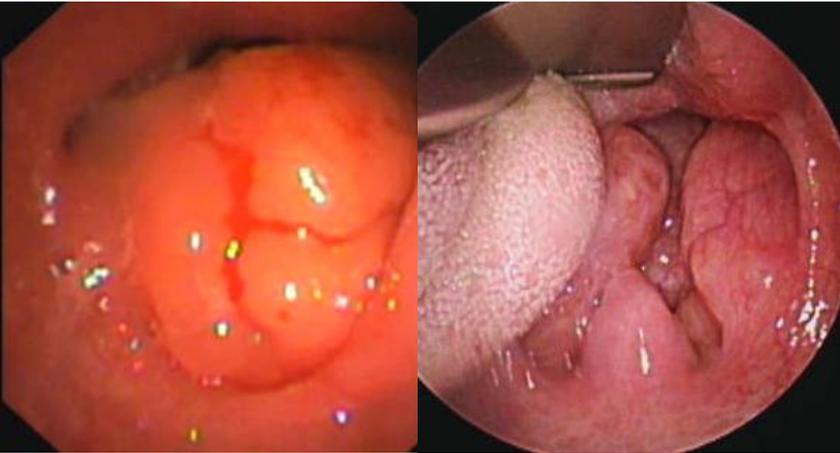


Imm.
Post op
Suboptimal airway

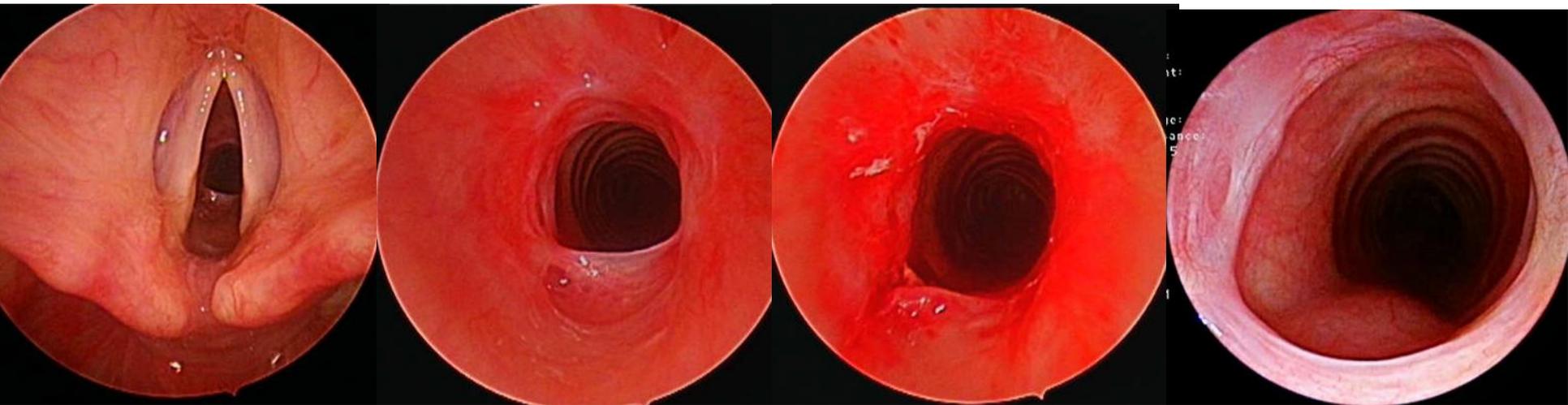


4 weeks
V - shaped cricoid

Grade I SGS



Adeno-tonsillar hypertrophy



- Kenacort
- Mercedes Benz* incision
- Balloon dilation

4 months

OPEN APPROACHES FOR SGS

....Outcome influencing parameters

1. CONGENITAL

- **Cricoid involvement**
 - Anterior / Posterior / Both
 - Small- hypoplastic- / Flattened

2. ACQUIRED

- **Site of the tracheostomy**
 - > +/- stoma static
 - > close to the stenosis / reconstruction site
- **Special situations**
 - associated secondary airway anomalies
 - multi- operated

OPEN AIRWAY RECLAIMING SURGERIES

LTR

PCTR

Extended PCTR

- Always DS

SS

- isolated SGS

DS

- Comorbidities
- Glottic involvement

INDICATIONS FOR LTRs

CONGENITAL

ACQUIRED



Glottic web



Elliptical cricoid



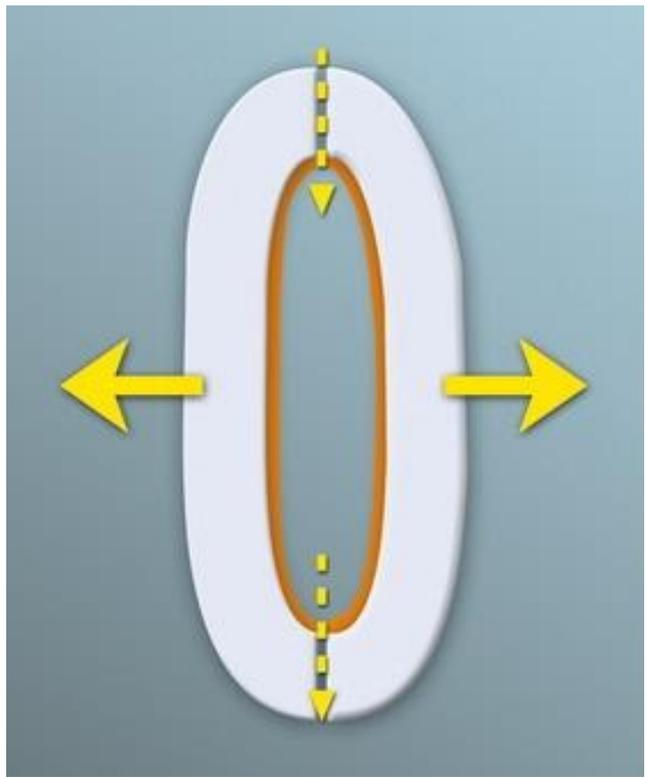
Purely PGS



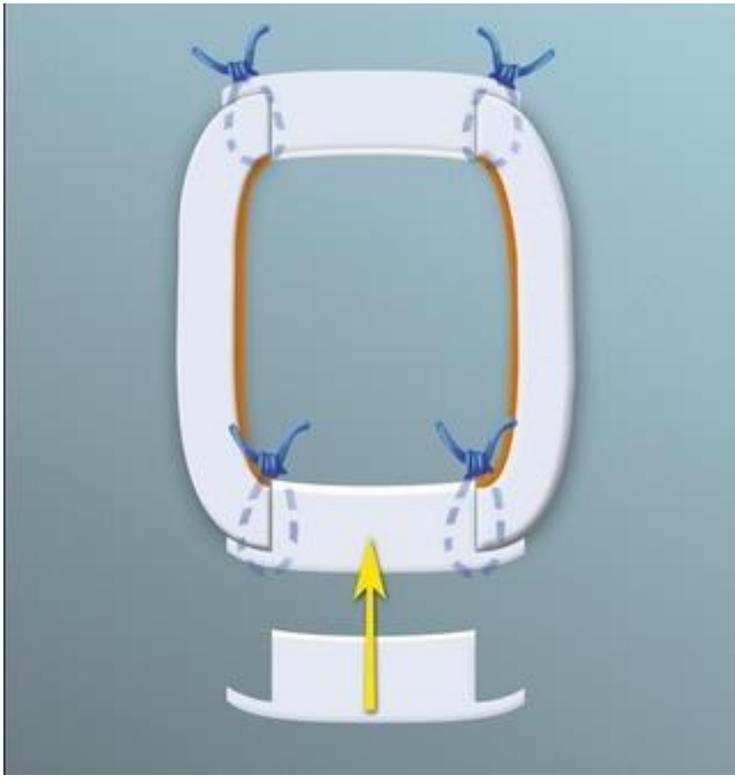
PGS + minor grade SGS

Elliptical cricoid ring

LARYNGOTRACHEAL RECONSTRUCTION

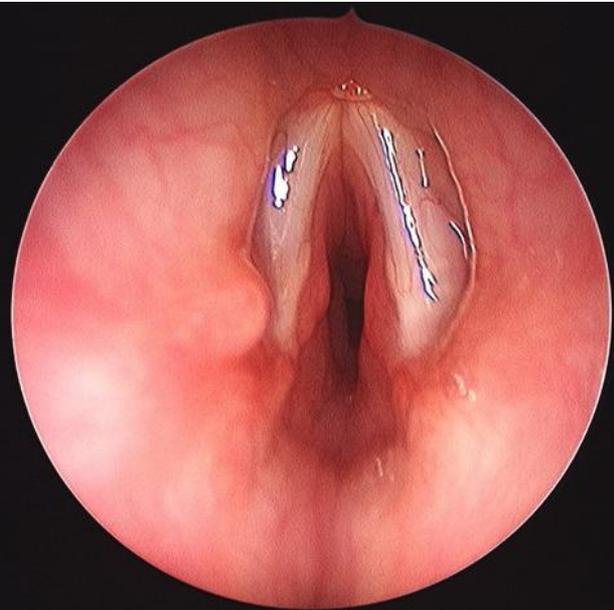


ANT + POST
CRICOID SPLIT

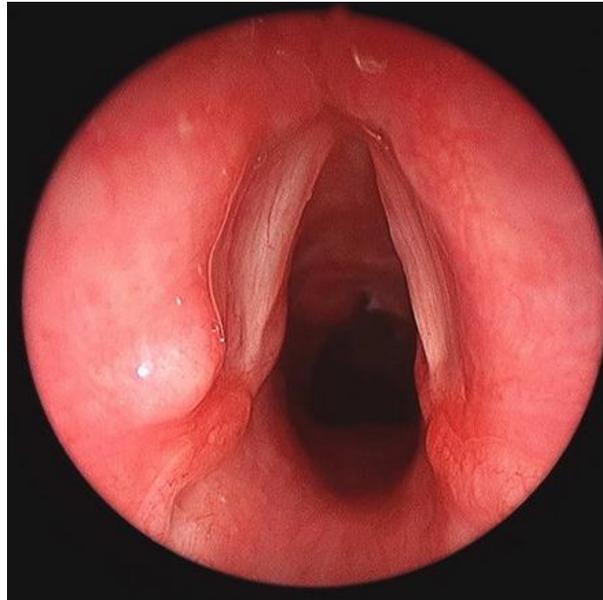


DOUBLE COSTAL
CARTILAGE GRAFT

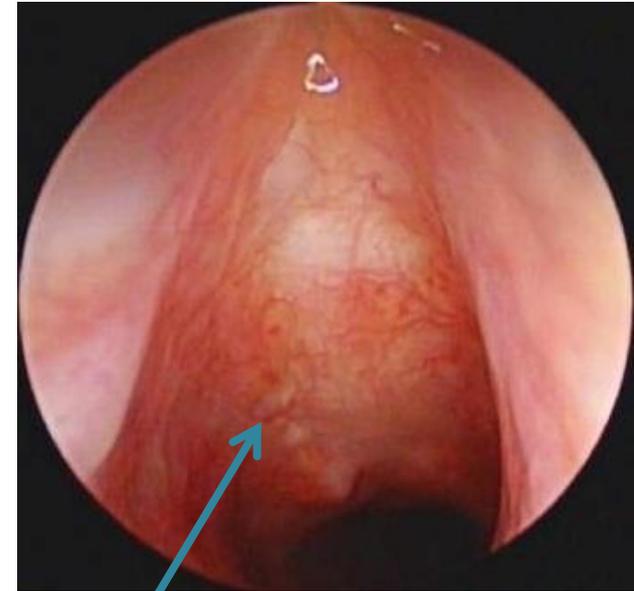
EXAMPLE



Preoperative view

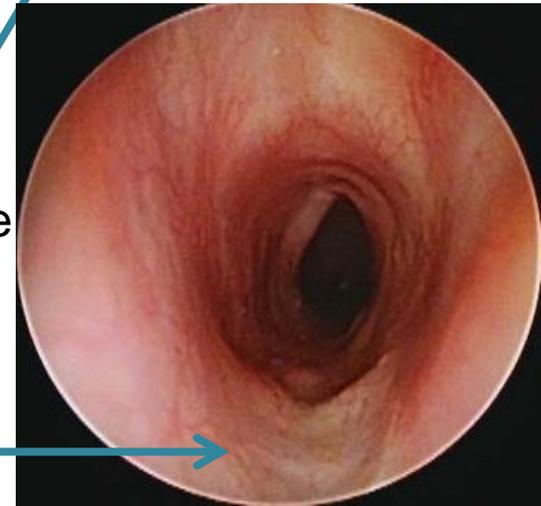


Postoperative view

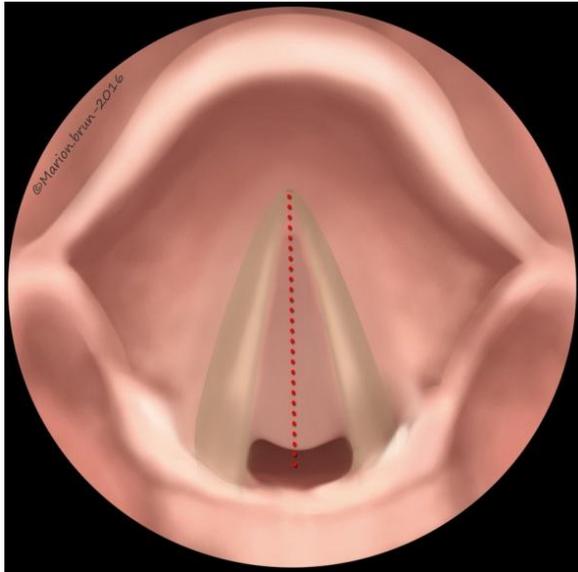


Anterior Costal Cartilage

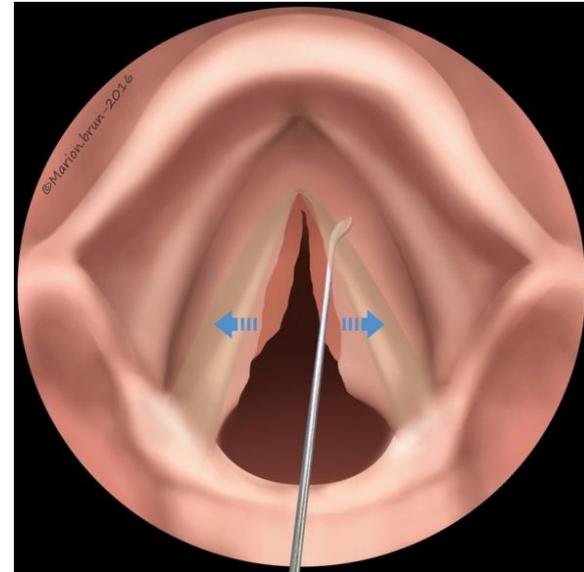
Posterior Costal Cartilage Graft



Combined approach for treating dense laryngeal webs



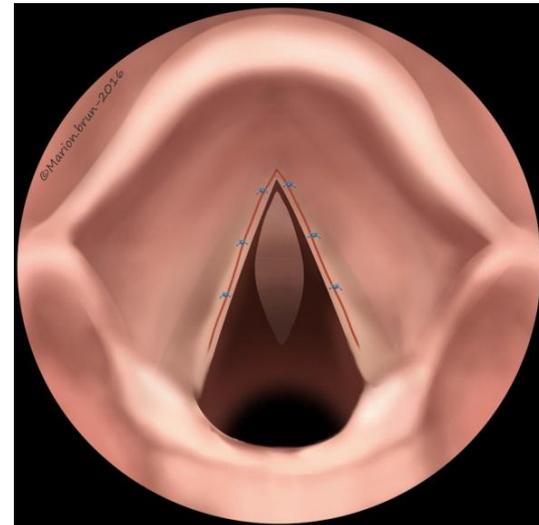
MLS: CO2 laser division of the web



Complete LF: Lateral mucosal dissection up to the Morgagni's ventricle

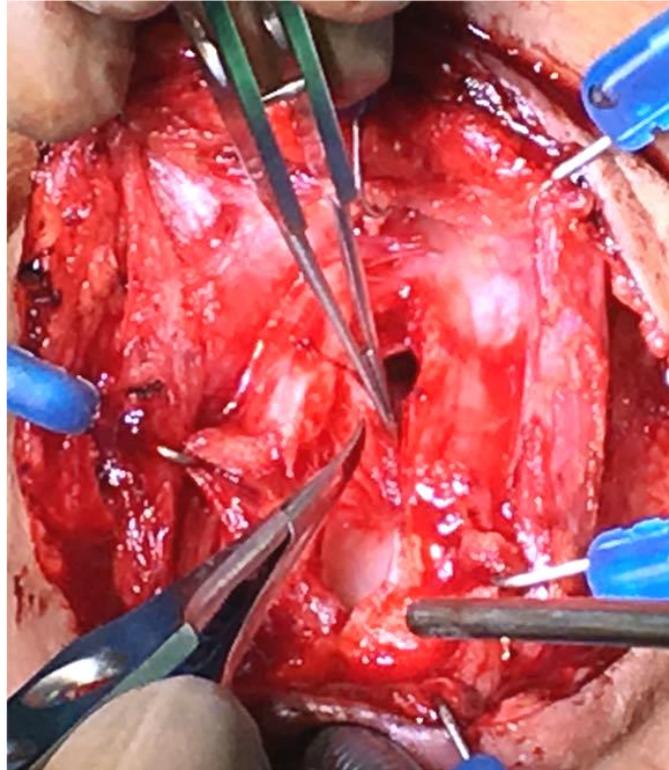


Mucosal mobilisation



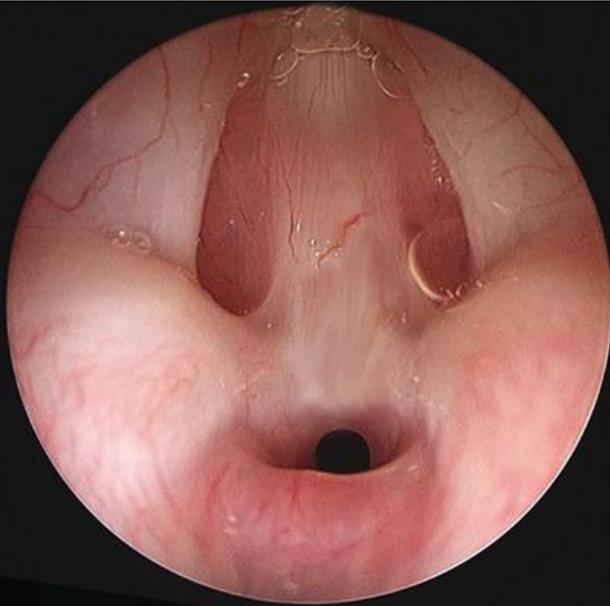
7.0 PDS, + ACCG + LT mold

Reclaiming glottic mucosa from the Morgagni's ventricle

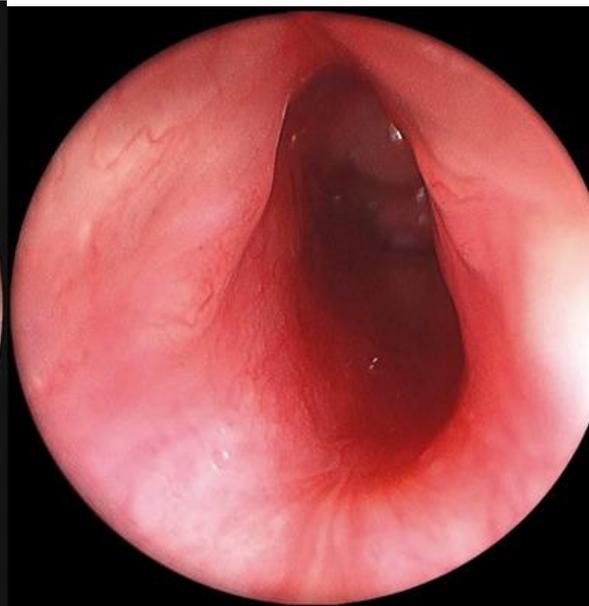


- 7.0 PDS
- Complete glottic mucosalisation

Combined approach for treating dense laryngeal webs



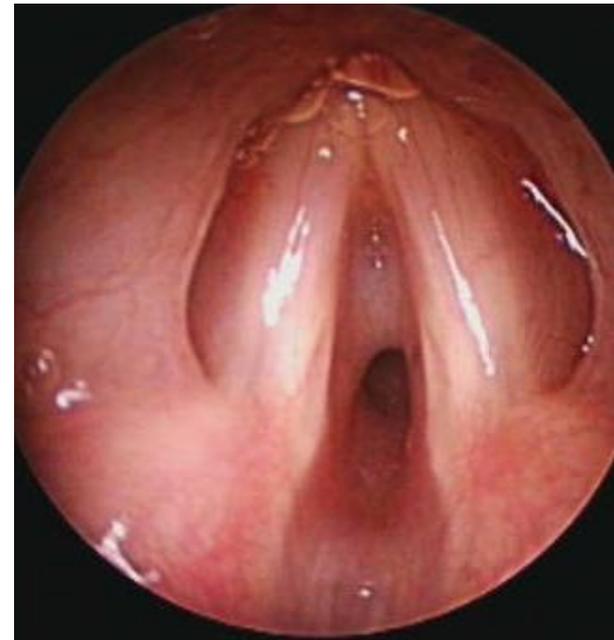
preoperative
view



postoperative view

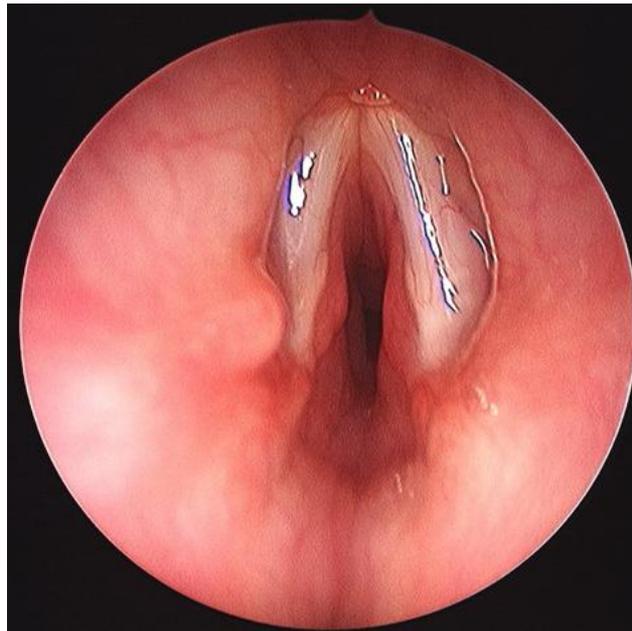
Time to decannulation: 76 d

EXAMPLES



thick anterior
lamina

ACCG



elliptical
shape

A+PCCG



generalized
thickening

PCTR

INDICATIONS FOR PCTRs

CONGENITAL

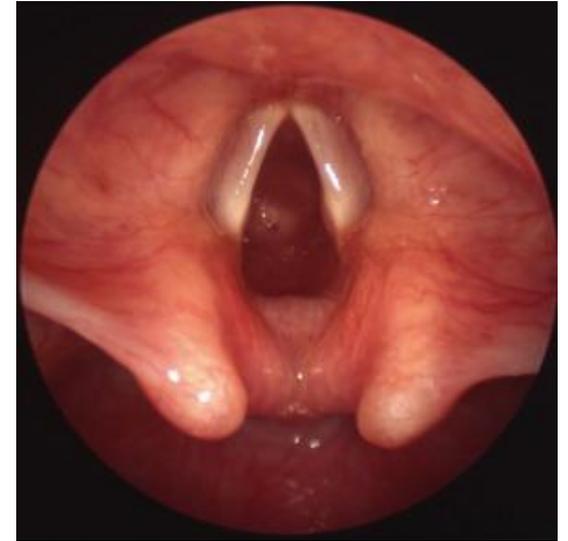
ACQUIRED



Generalized thickening

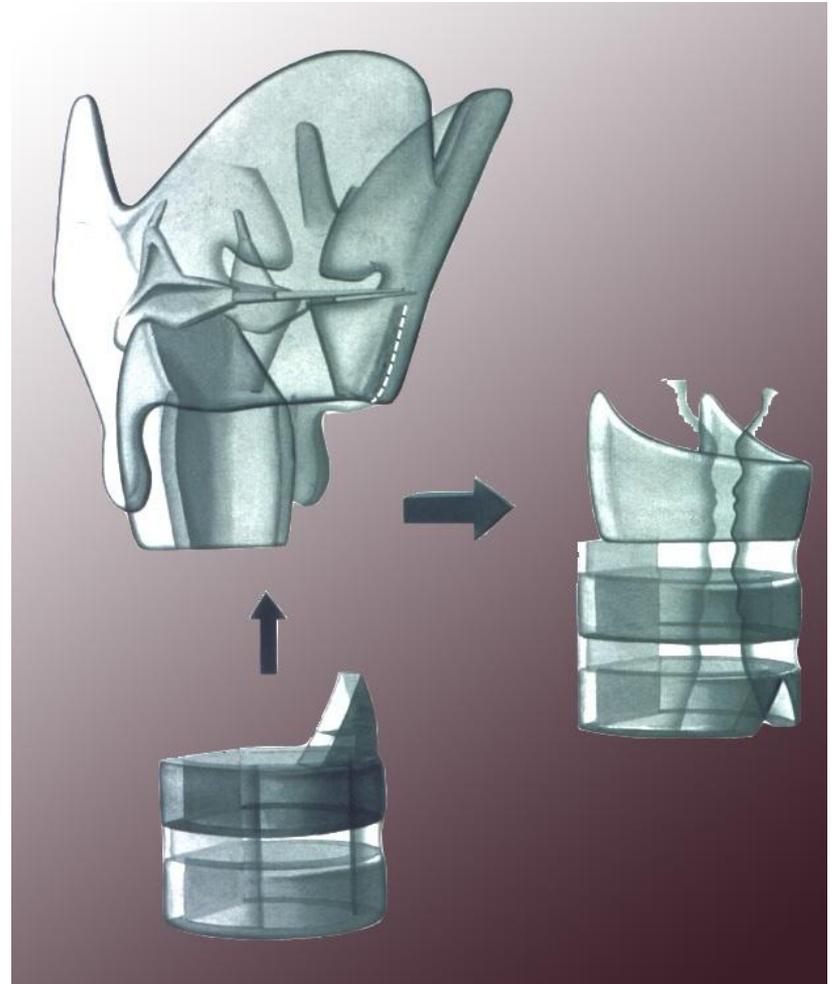
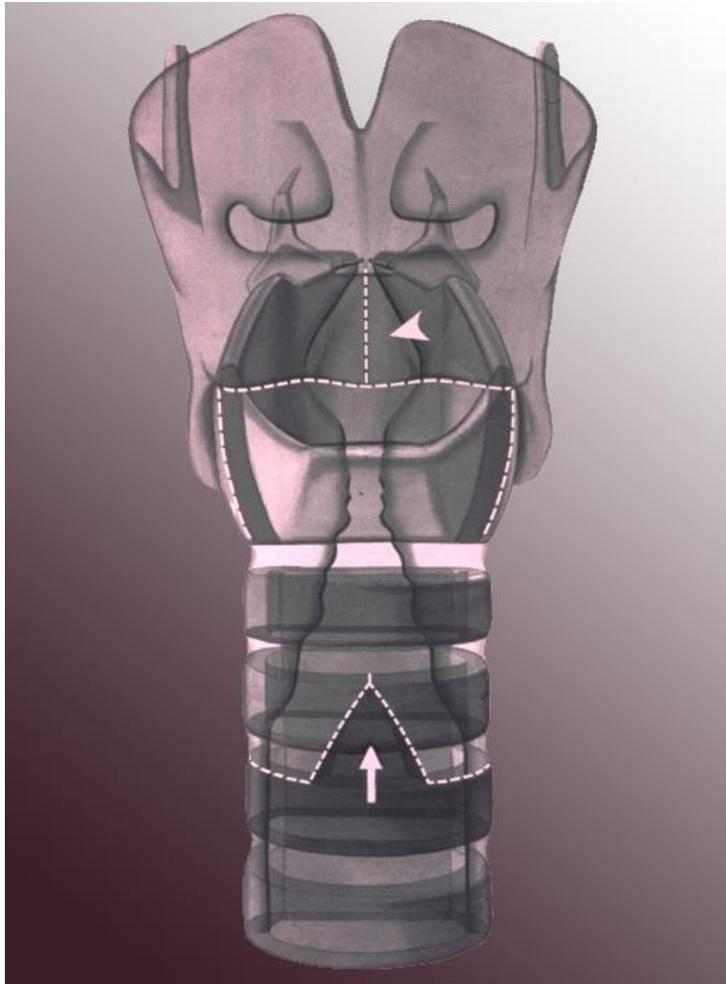


Grade III
SGS



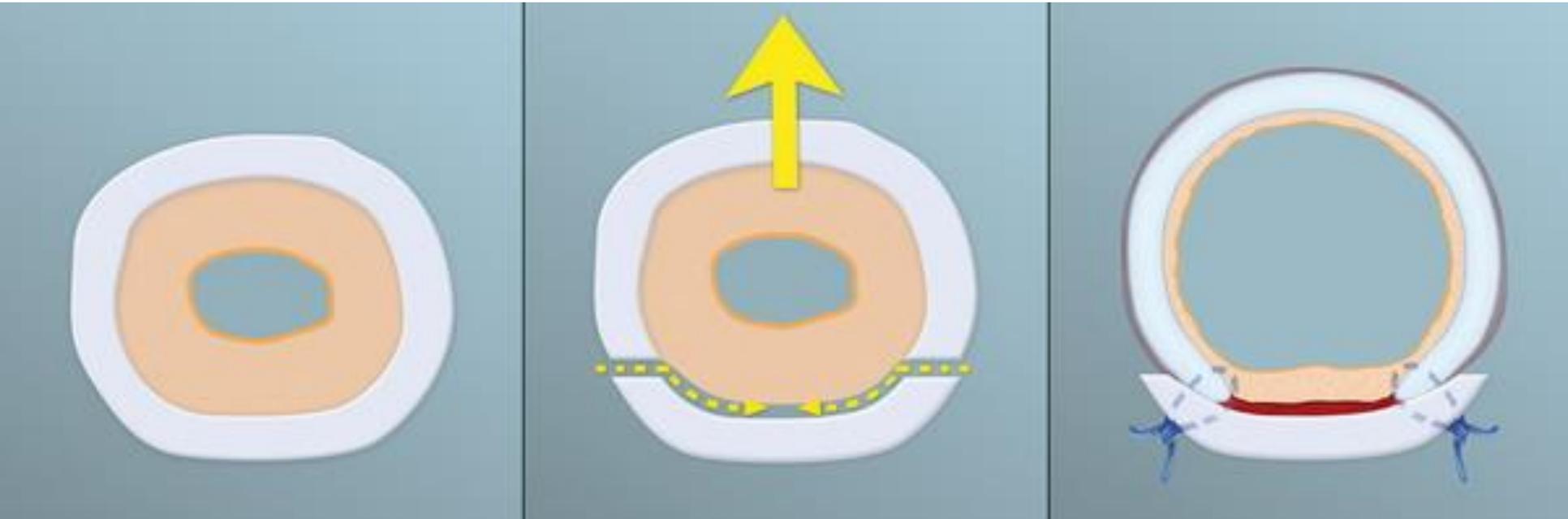
Grade IV
SGS

PRINCIPLE



FLATTENED CRICOID RING + SUBMUCOSAL HYPERPLASIA

CRICOTRACHEAL RESECTION



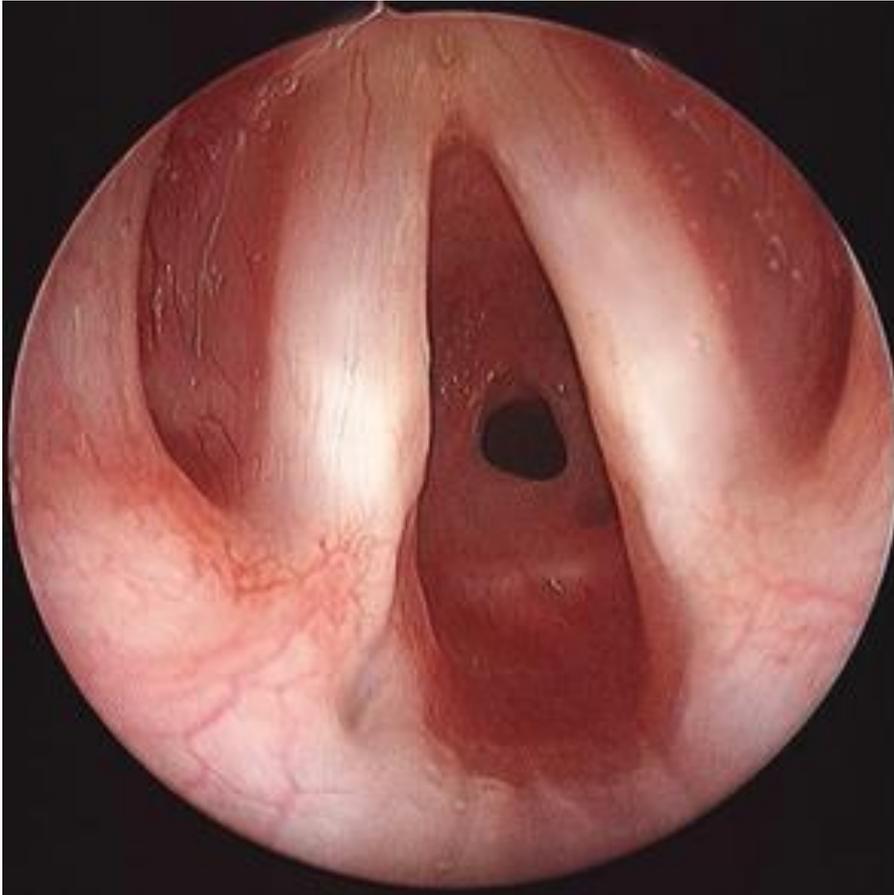
flattened / small cricoid
+
submucosal hyperplasia

CTR

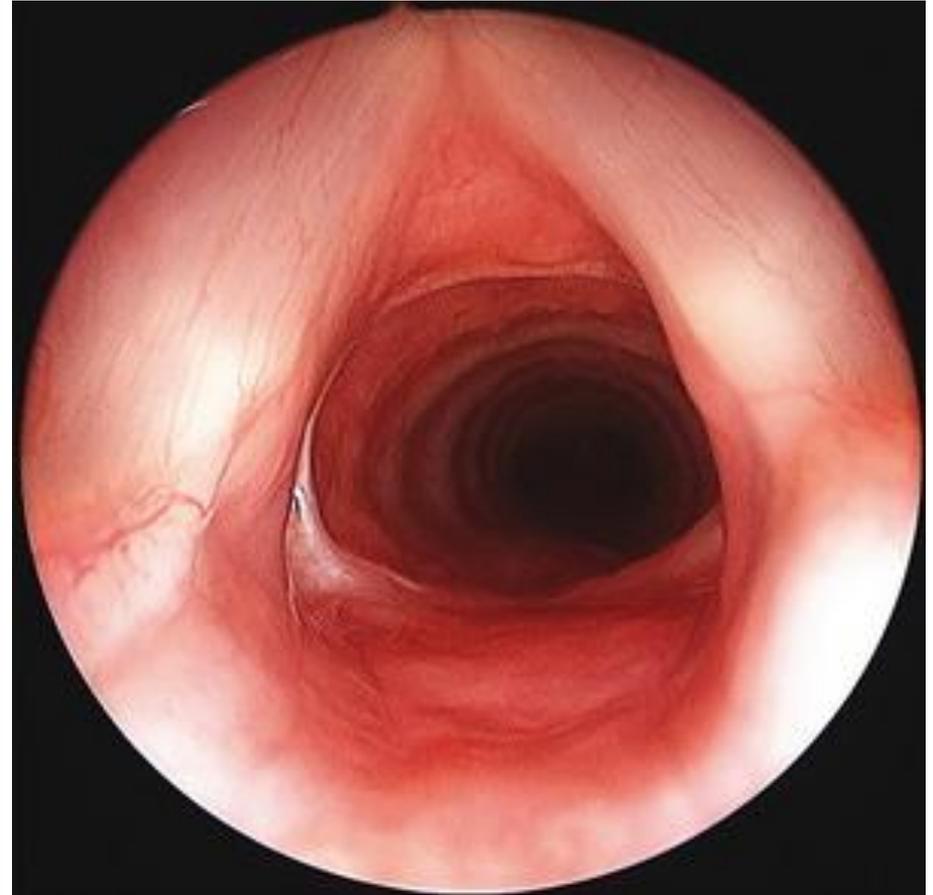
result post-thyro-
tracheal
anastomosis

Generalised thickening

SINGLE-STAGE SURGERY



preoperative view



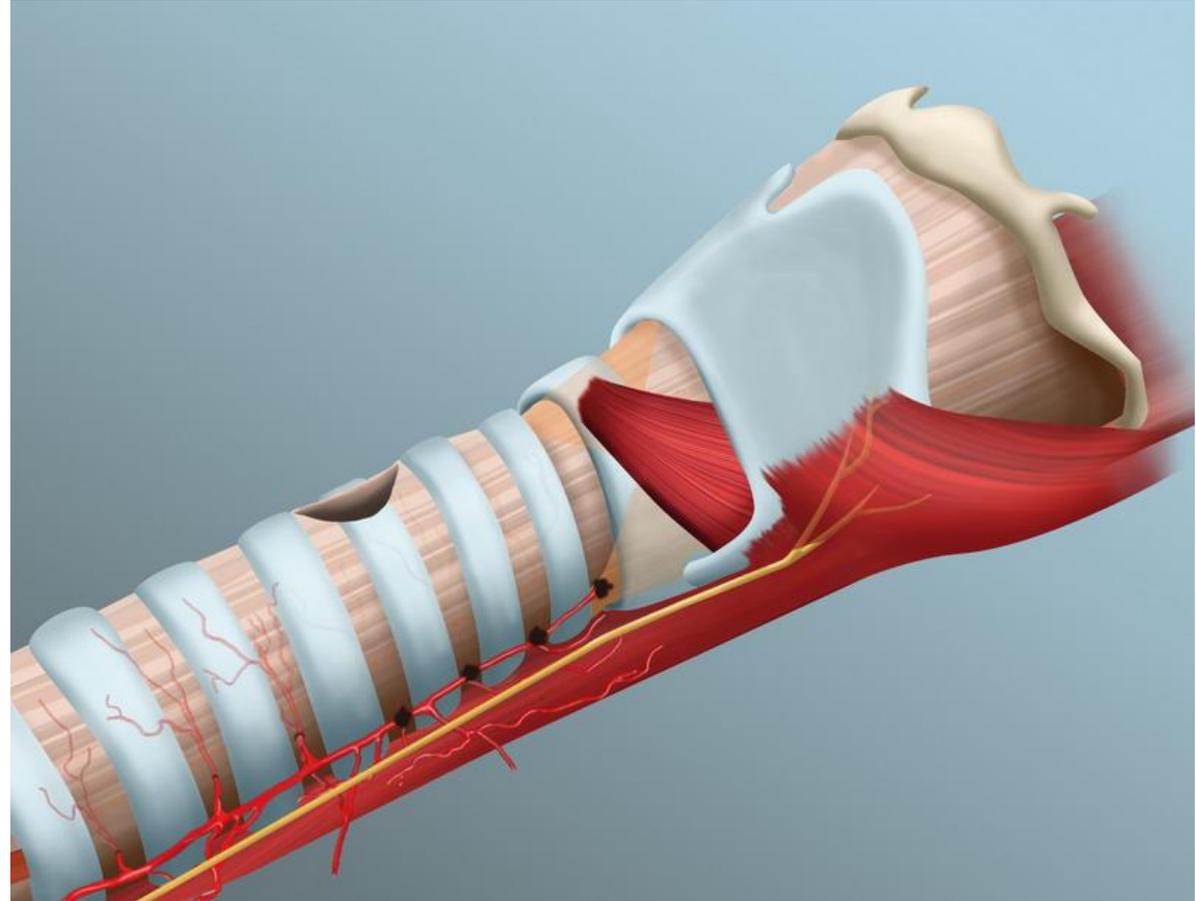
postoperative view
at 18 months

- > Collar incision
- > Crescent-Shape excision around tracheostoma
- > Midline division of strap muscles and thyroid gland



LARYNGOTRACHEAL DISSECTION

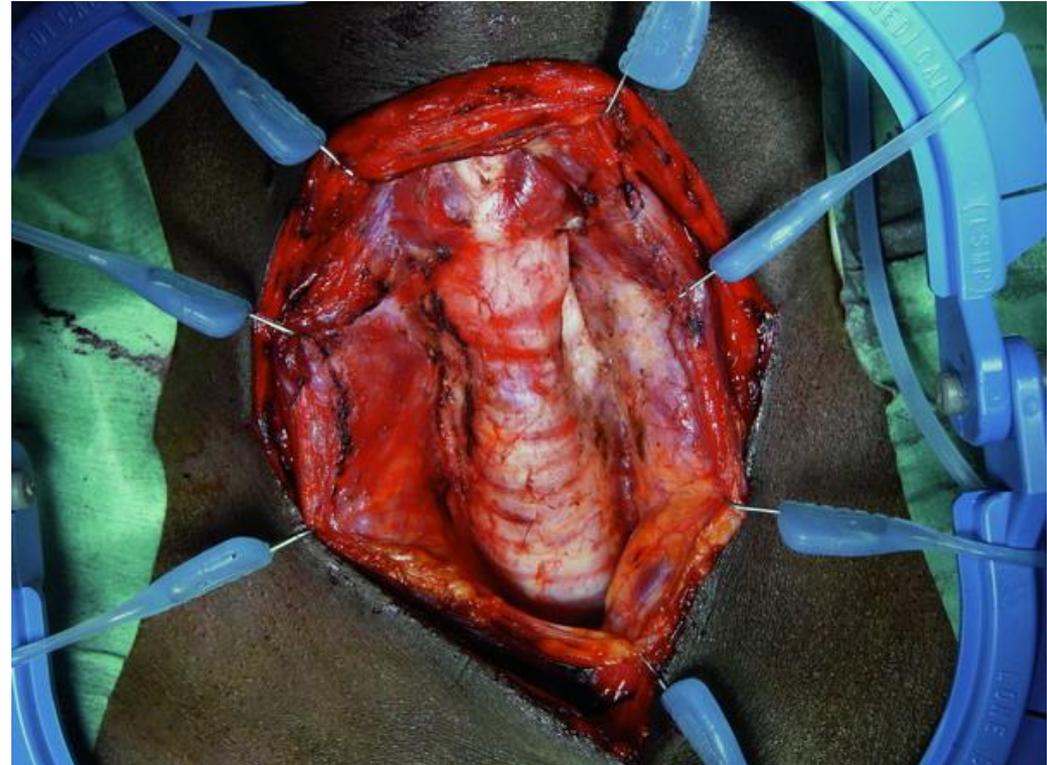
- hyoid bone
→ sternal notch
- close contact
with tracheal rings
- no identification
of RLNs
- preservation
of blood supply



LARYNGOTRACHEAL DISSECTION



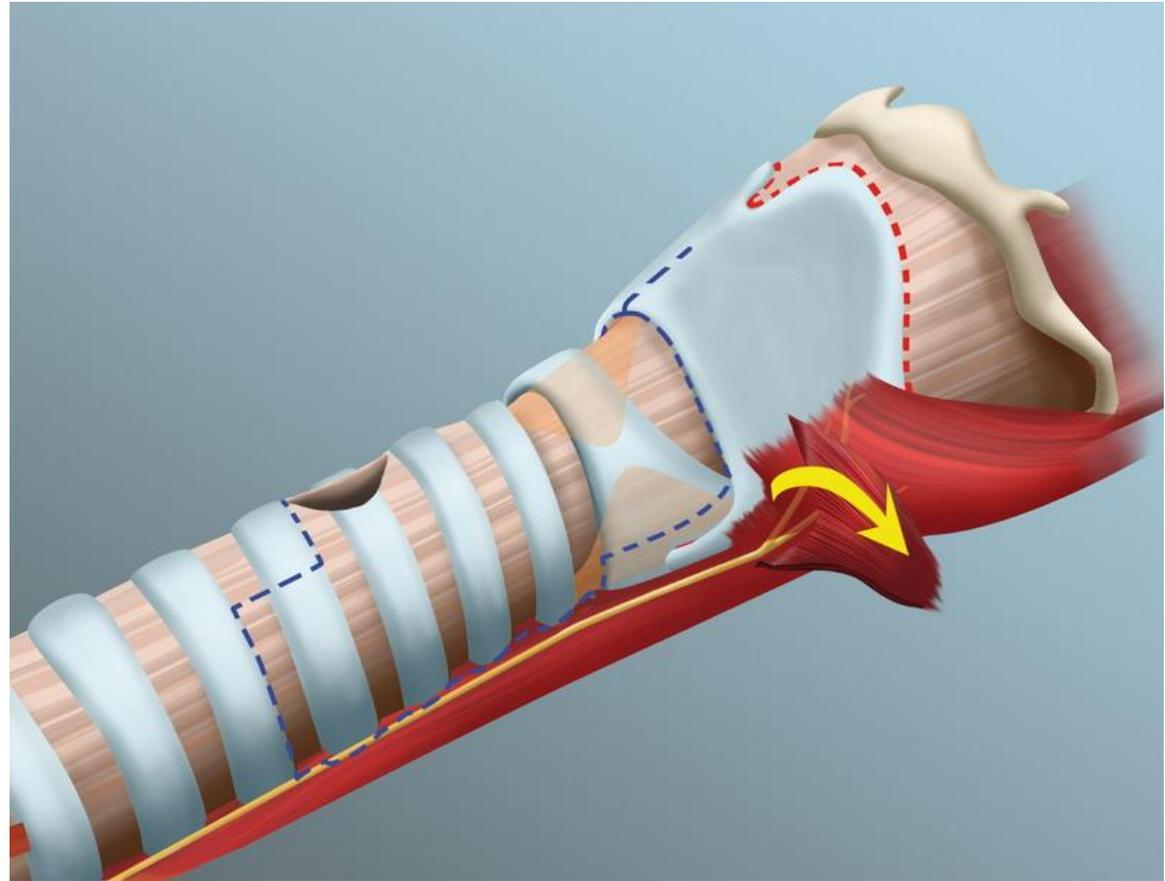
Kocher clamp
to facilitate
tracheal dissection



Retractor ring
with
elastic stay hooks

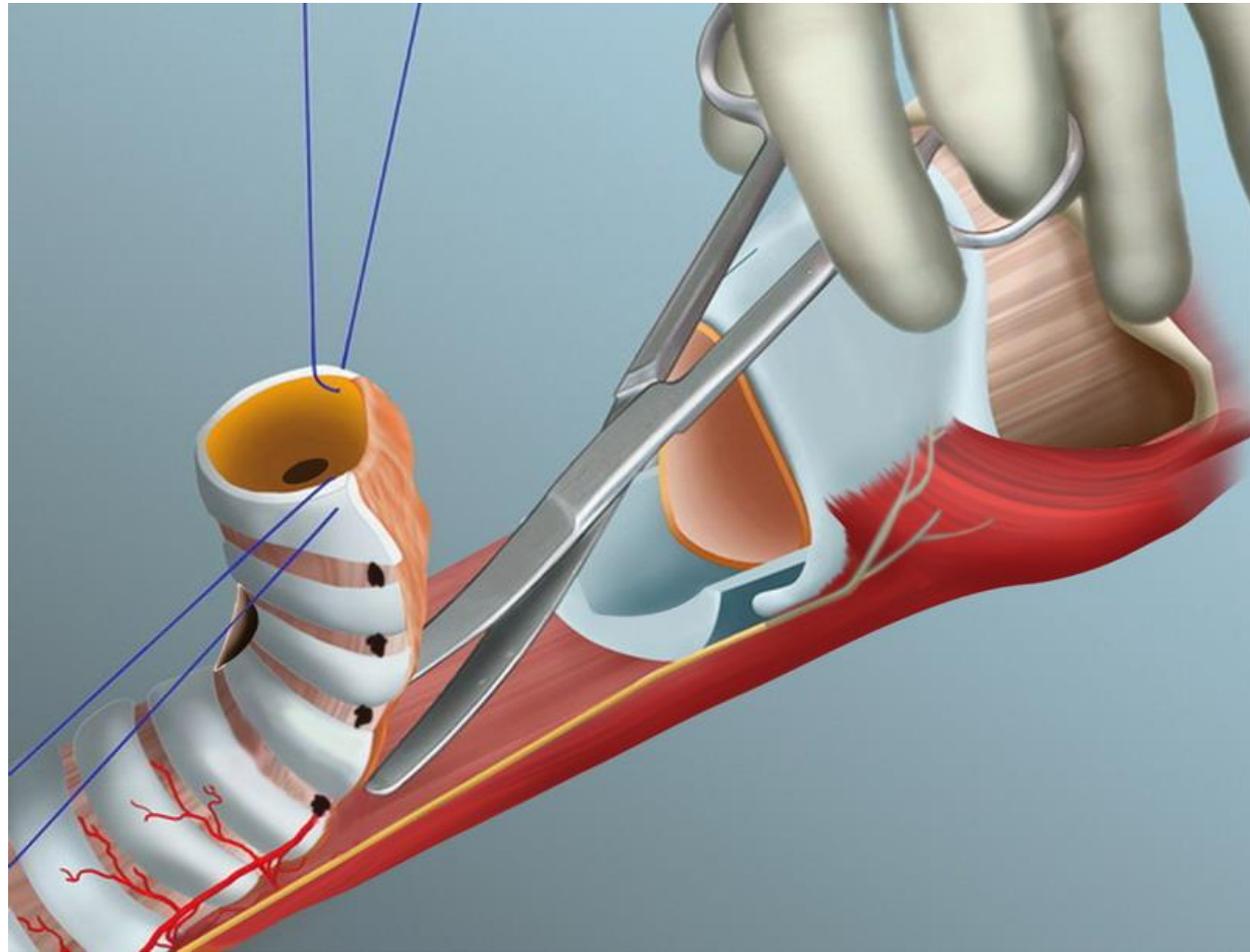
RESECTION LINES

- > Superior resection line
 - inferior border of thyroid cartilage
- > Inferior resection line
 - first normal tracheal ring
- > Lateral resection line
 - anterior to cricothyroid joints

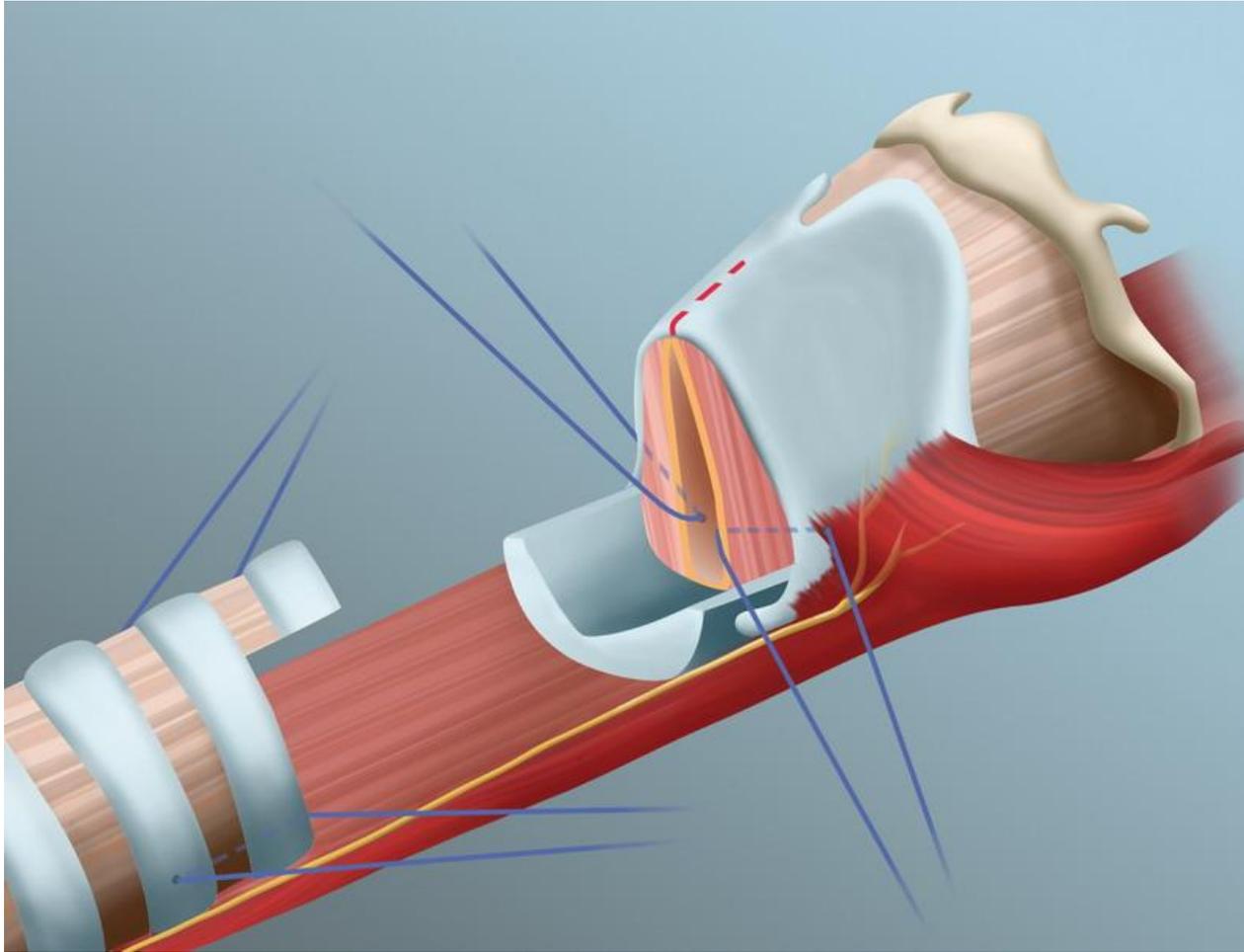


TRACHEAL STUMP

- Cranial mobilization of tracheal stump
- Limited tracheo-esophageal separation

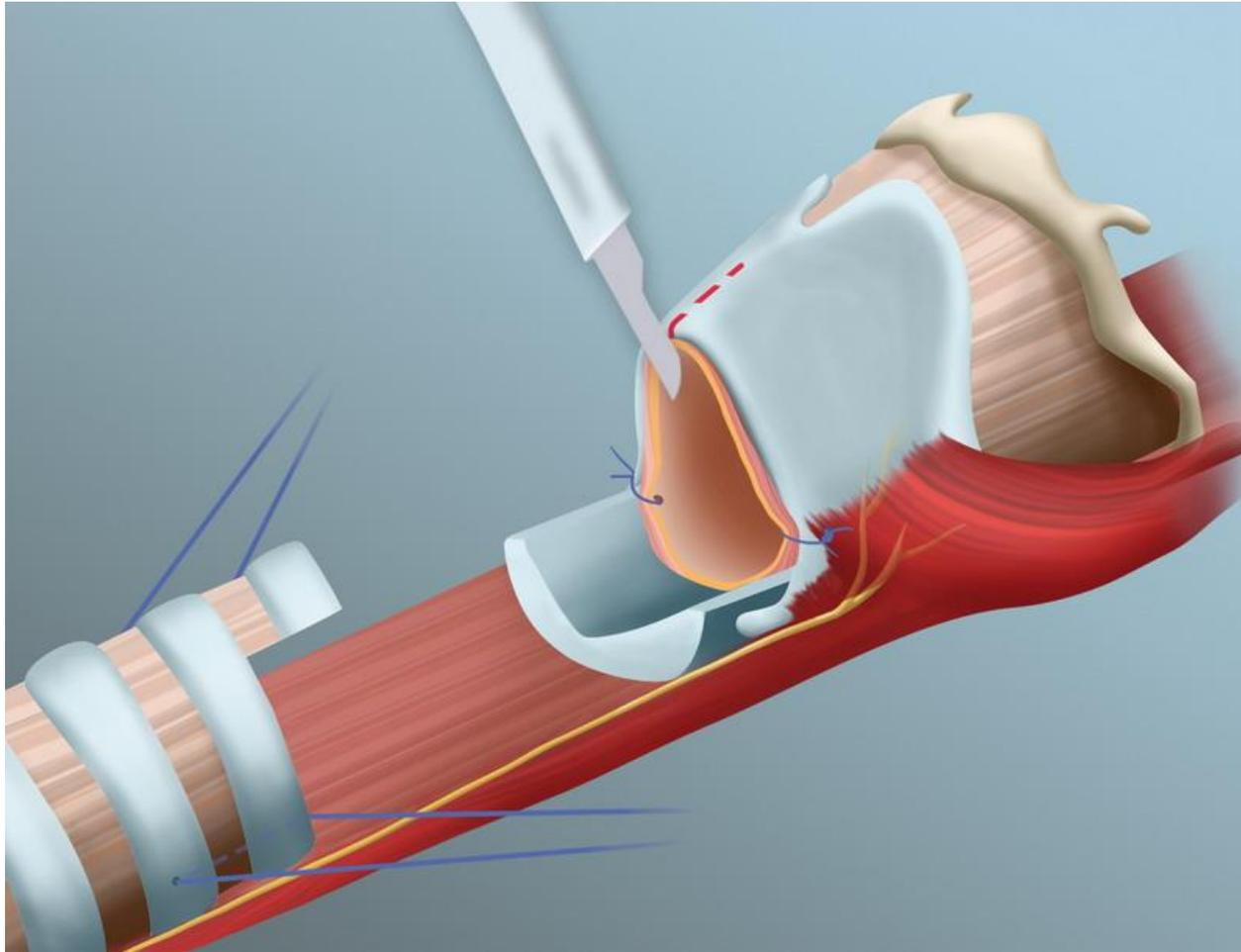


SUBGLOTTIC ENLARGEMENT

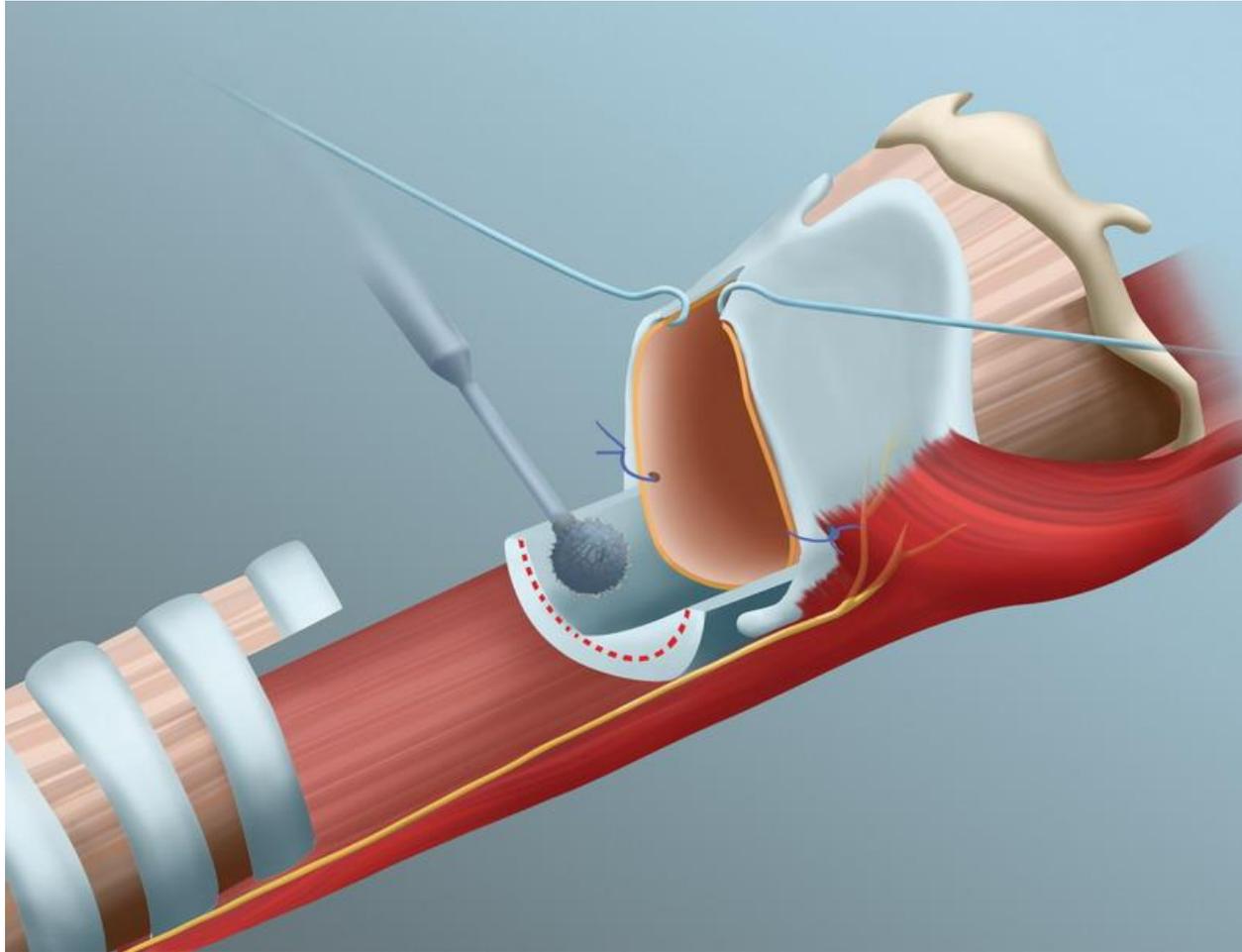


Lateral suture of subglottic mucosa to thyroid cartilage

SUBGLOTTIC ENLARGEMENT

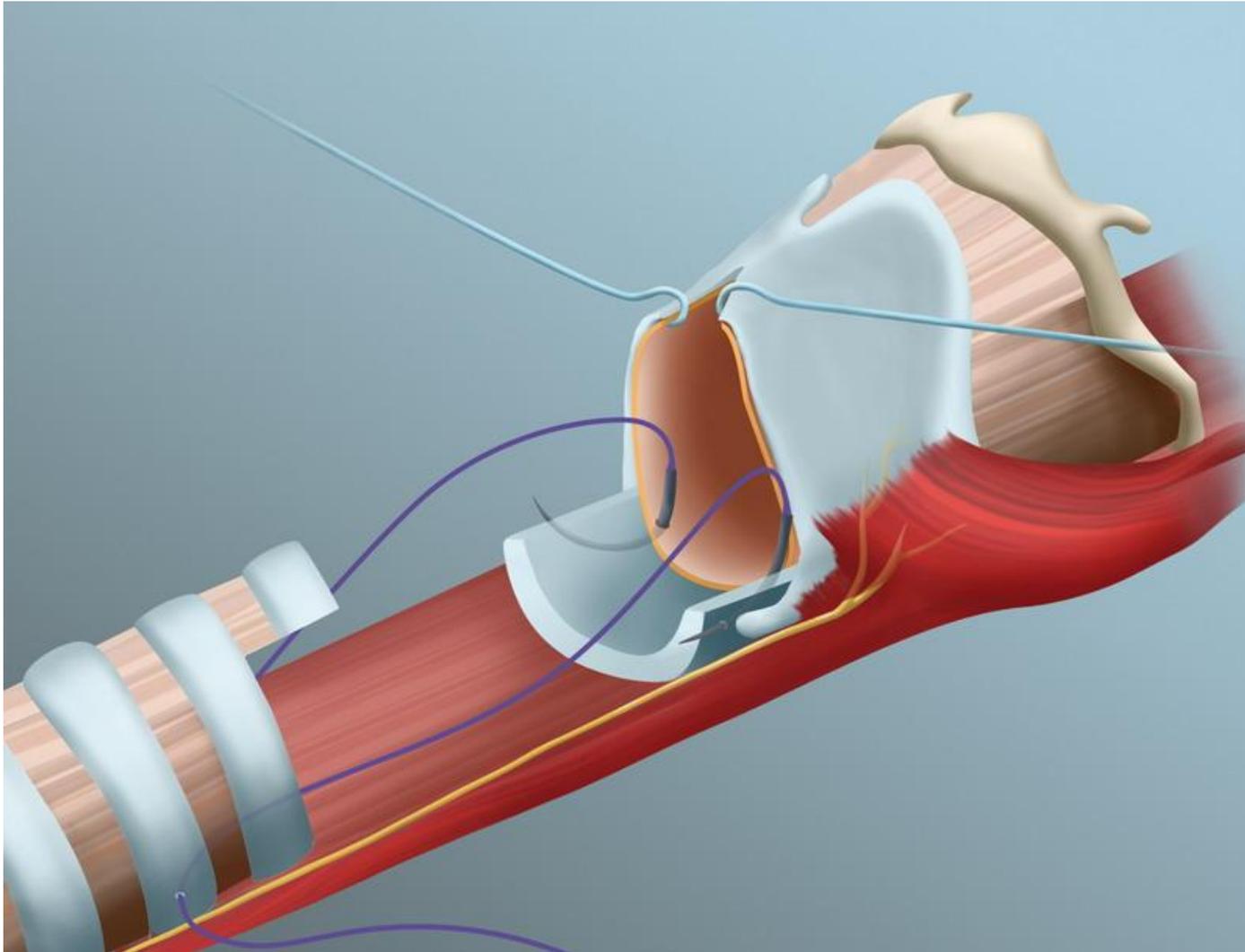


SUBGLOTTIC ENLARGEMENT

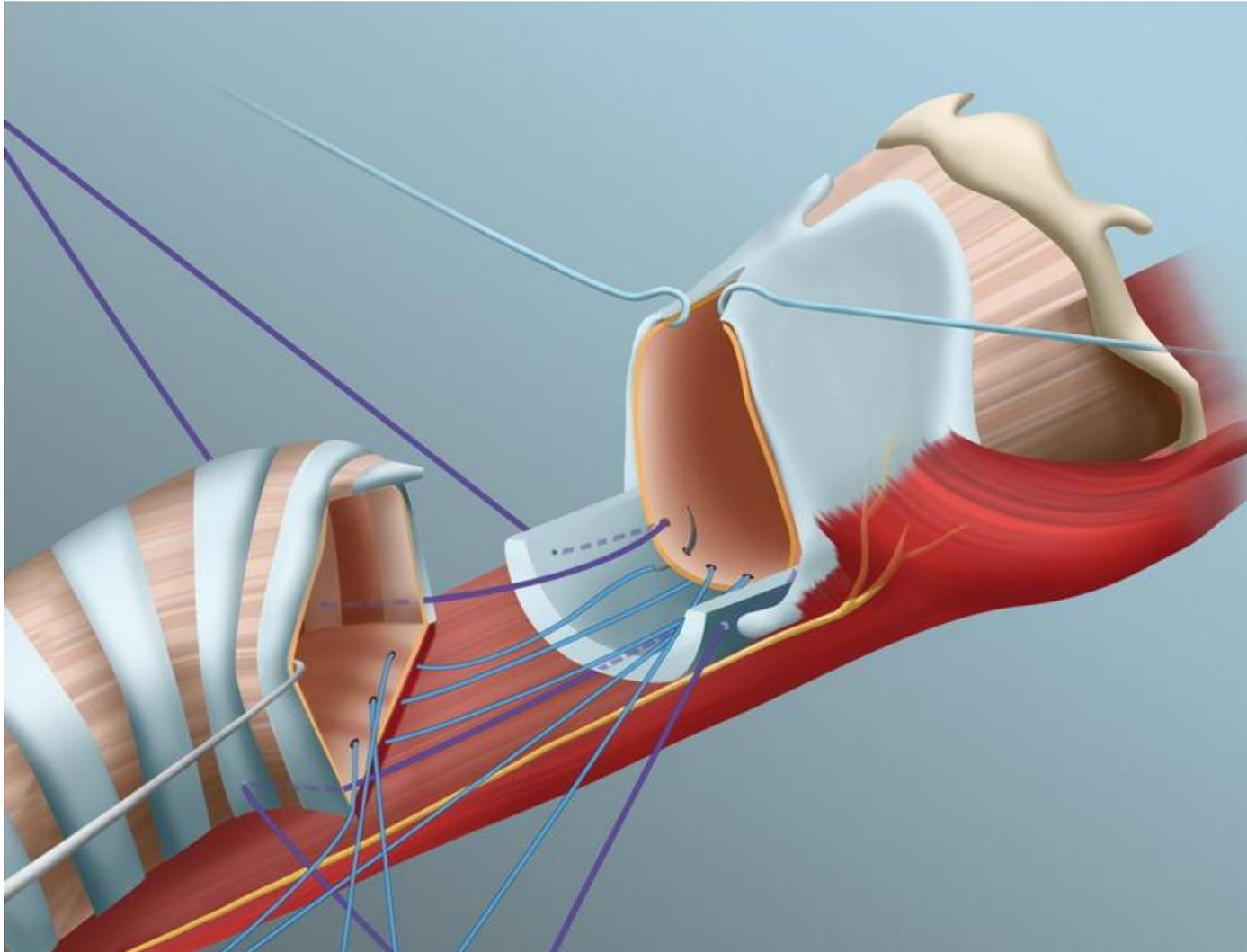


Widening and flattening cricoid plate with a diamond burr

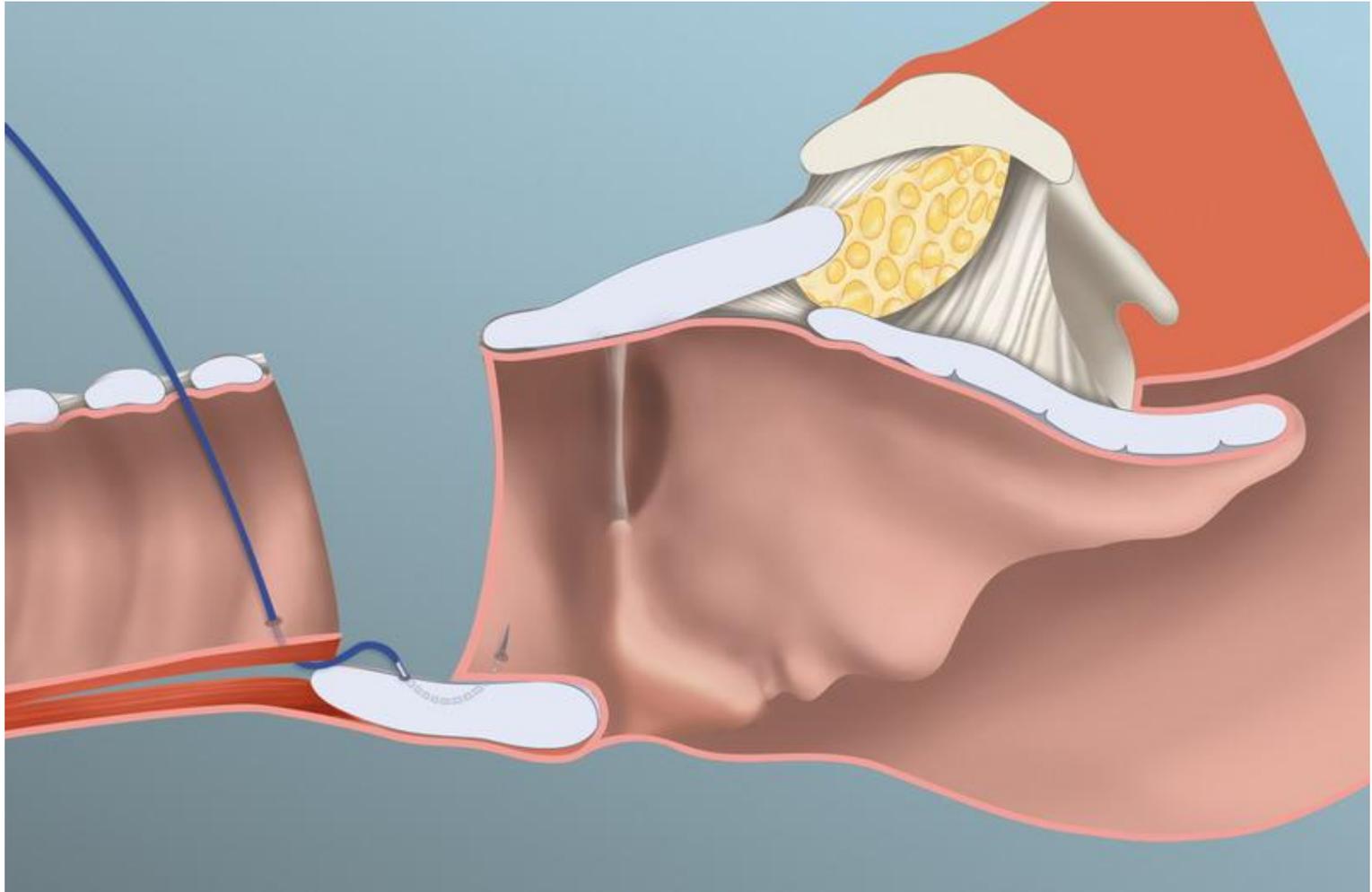
POSTEROLATERAL STITCHES



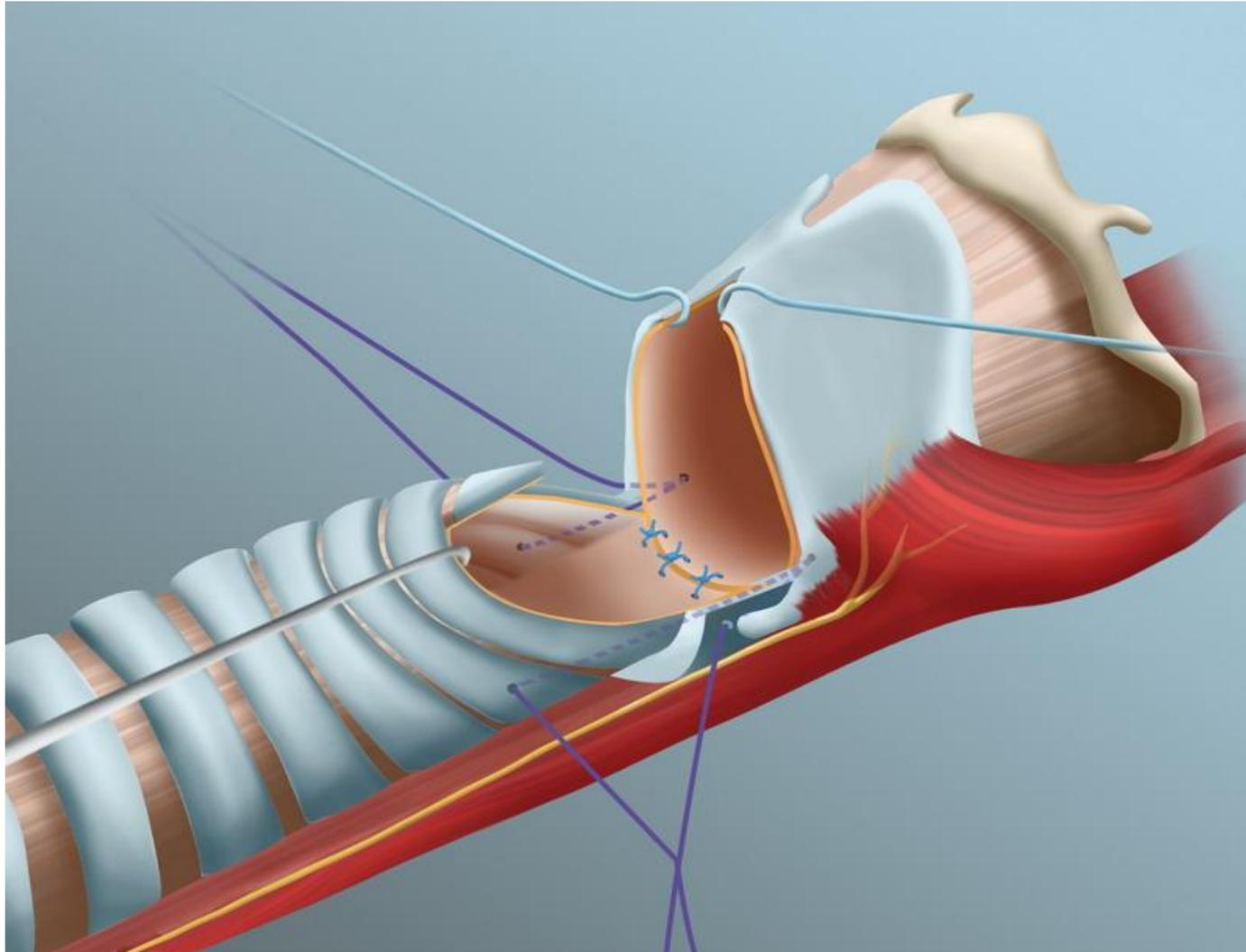
POSTERIOR ANASTOMOSIS



POSTERIOR ANASTOMOSIS

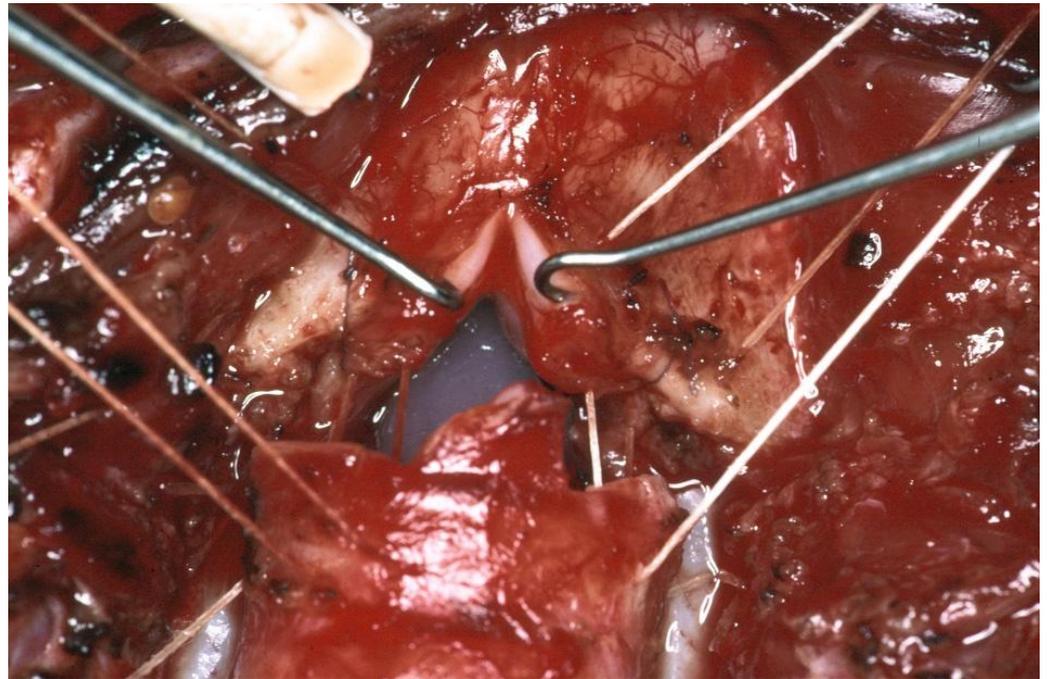


POSTERIOR ANASTOMOSIS

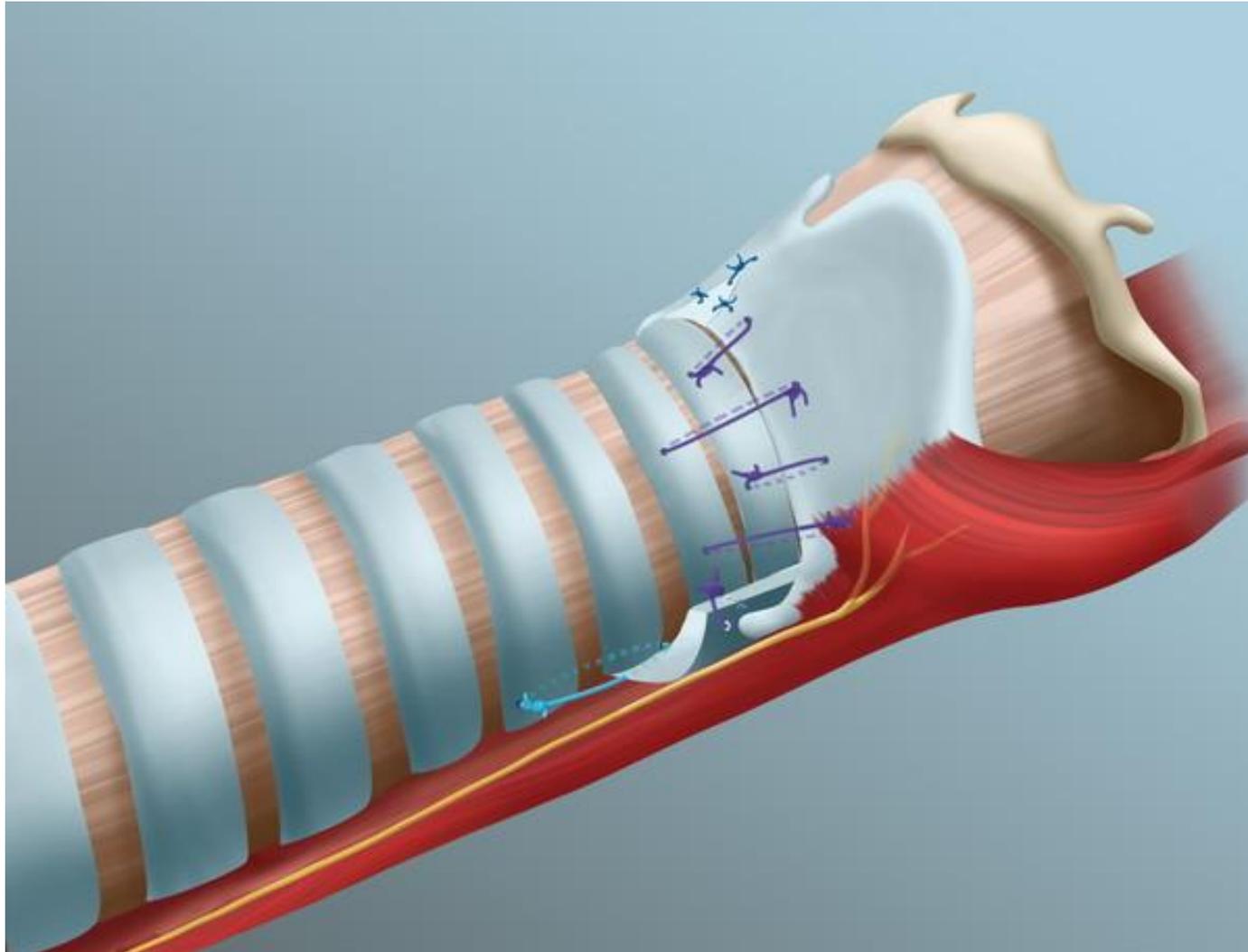


WIDENING OF SUBGLOTTIC LUMEN

- > wedge of pedicled cartilage to fit thyroid defect
- > increase in subglottic lumen



FINAL ANASTOMOSIS



CLASSICAL INDICATION

- Purely SGS
- Grade III or IV
- Normal VC function



SINGLE-STAGE SURGERY

EXTENDED PCTR WITH PCCG

- Principle

- > PCTR + PCCG

- > reconstruction of a steady,
fully mucosalized airway

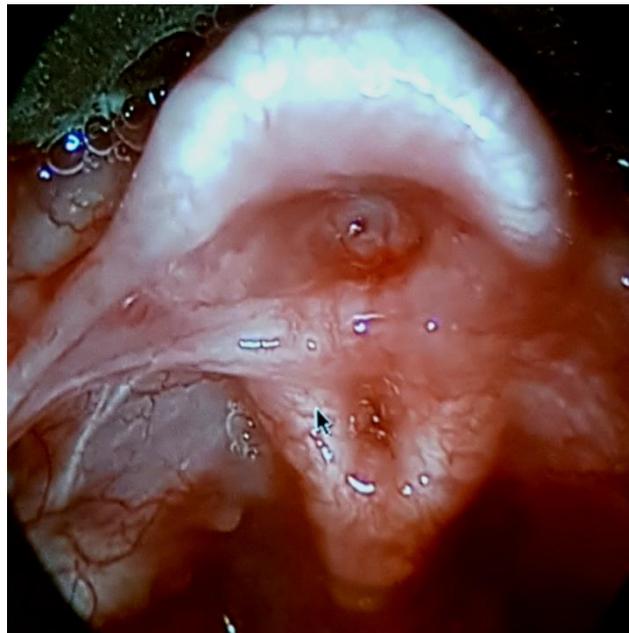
- > Mandatory 2 stage procedure

INDICATIONS FOR E-PCTRs

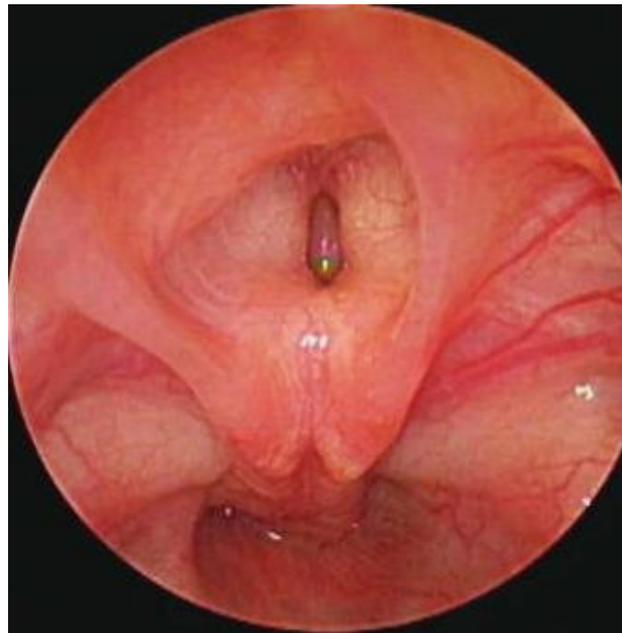
CONGENITAL

LARYNGEAL ATRESIA: ASSOCIATED SGS, CRICOARYT. ANKYLOSIS

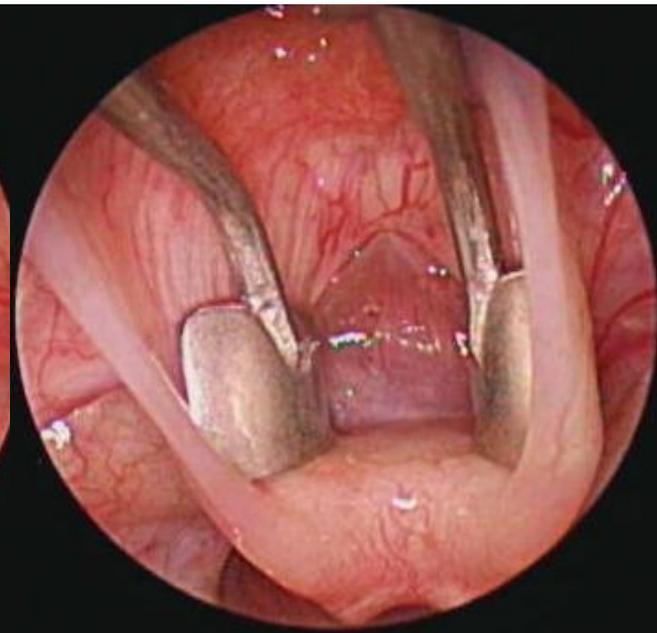
- Benjamin et al.



Supraglottic web

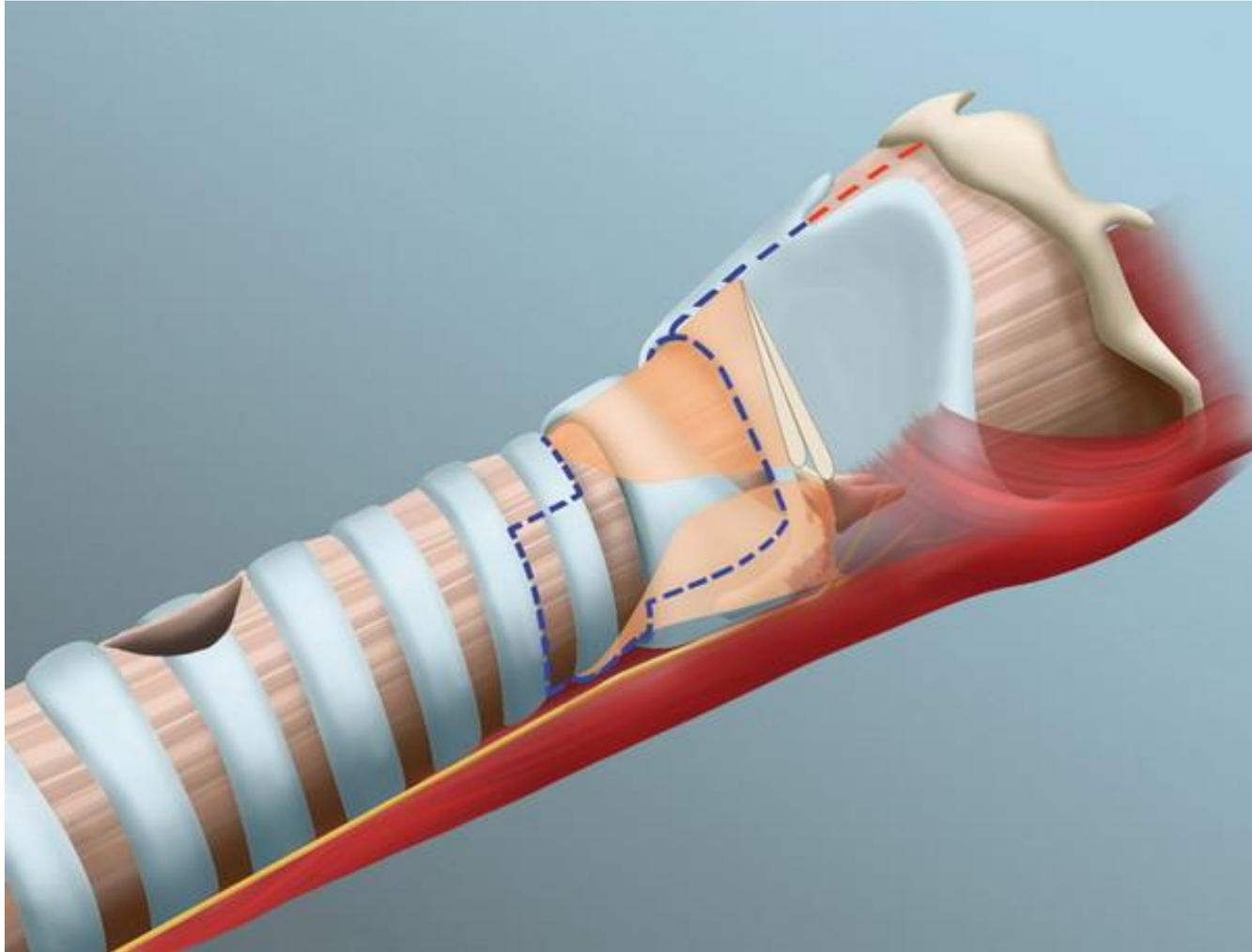


Glottic web



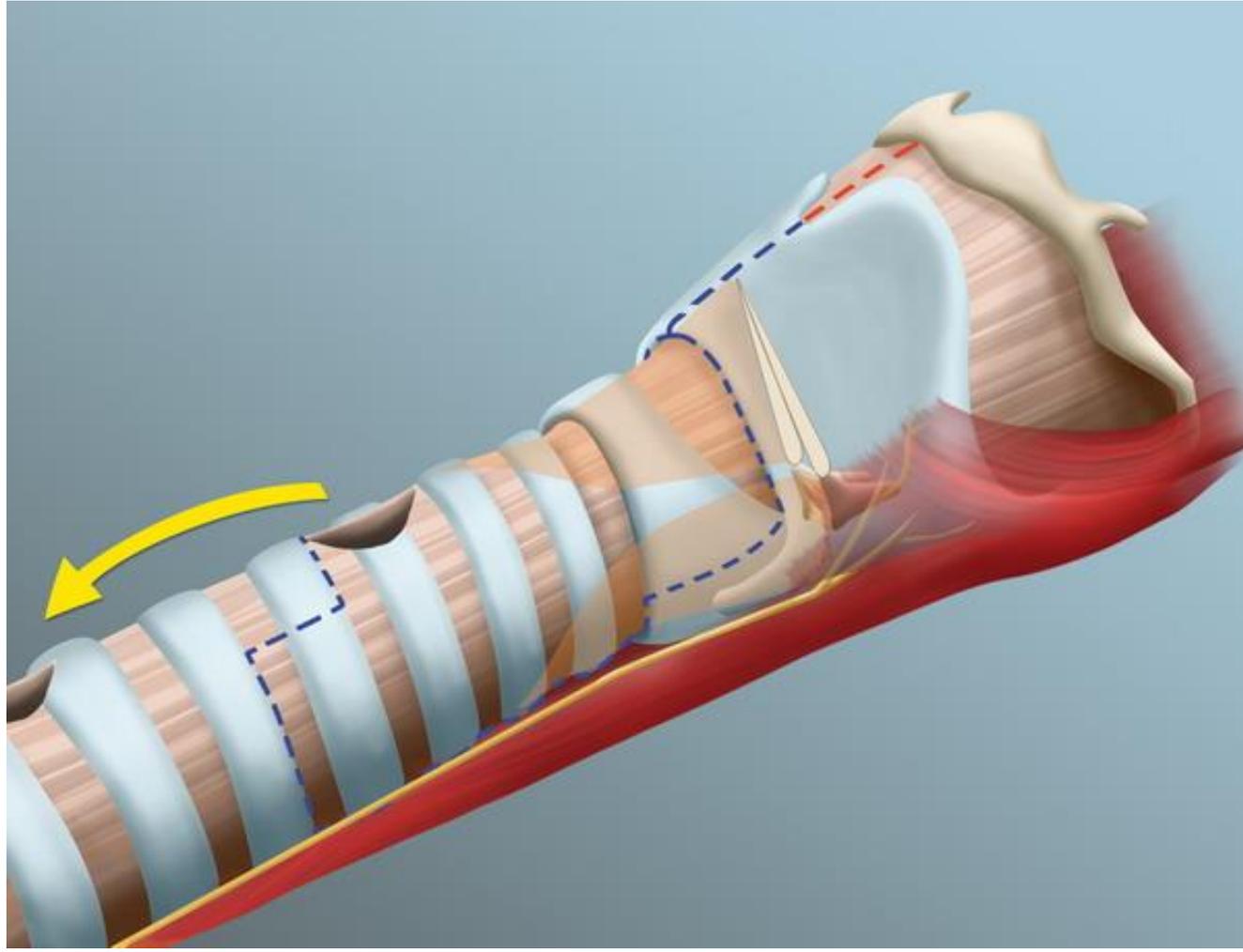
Transglottic LTS with bilateral CAA

EXTENDED PCTR



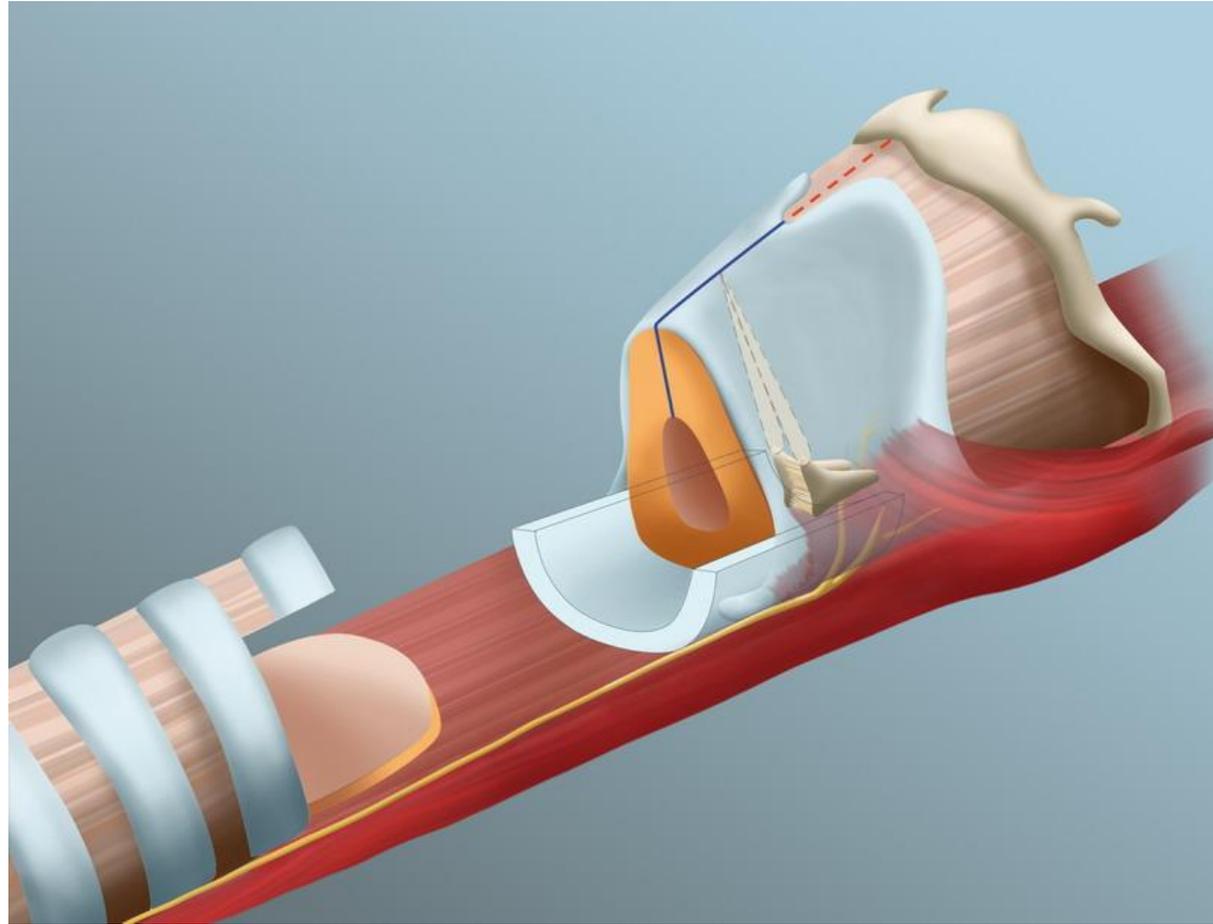
Transglottic LTS with bilateral CAA

EXTENDED PCTR



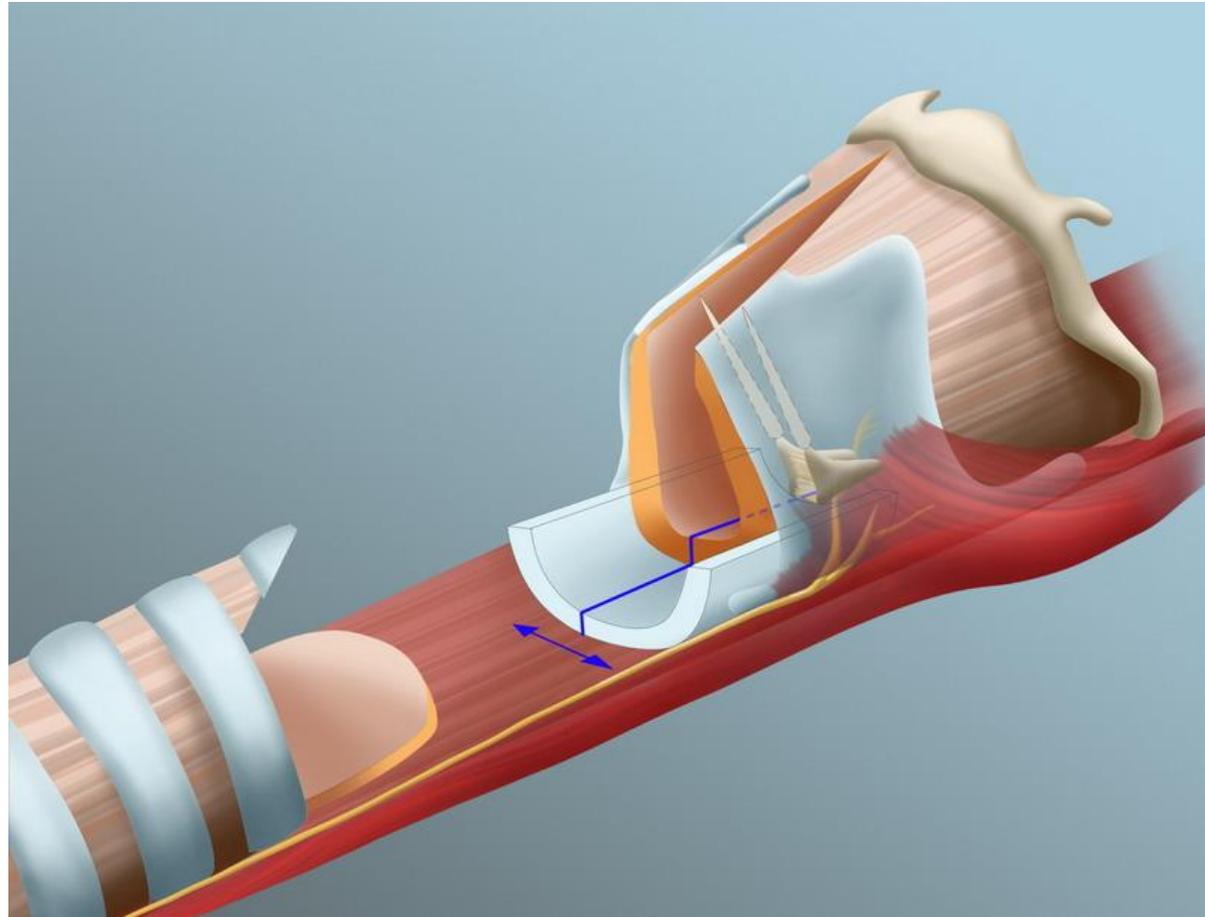
EXTENDED PCTR ①

- > PCTR
- > Pedicled flap of posterior tracheal mucosa
- > Full laryngofissure
- > Submucosal excision of fibrous tissue



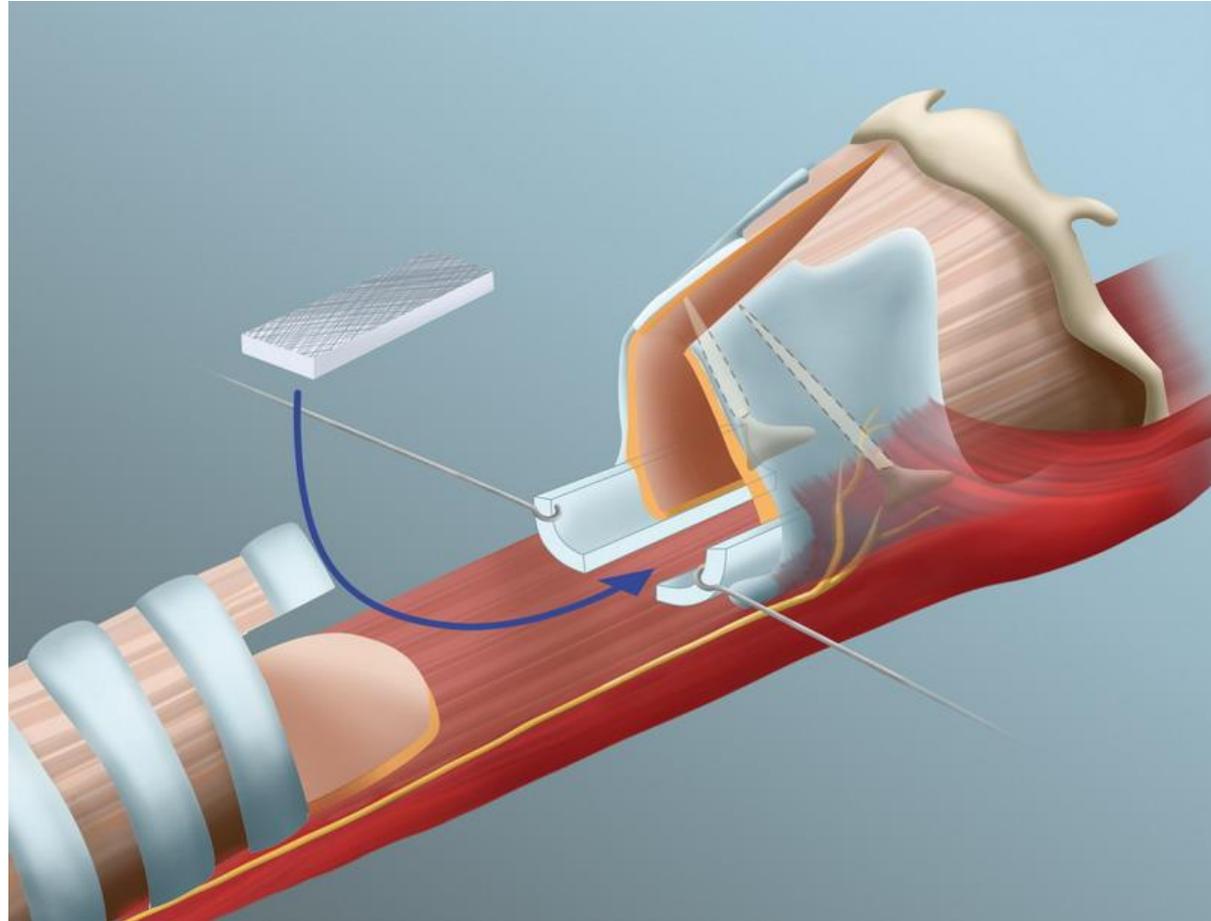
EXTENDED PCTR ②

- > Posterior cricoid split
- > Section of transverse interarytenoid muscle

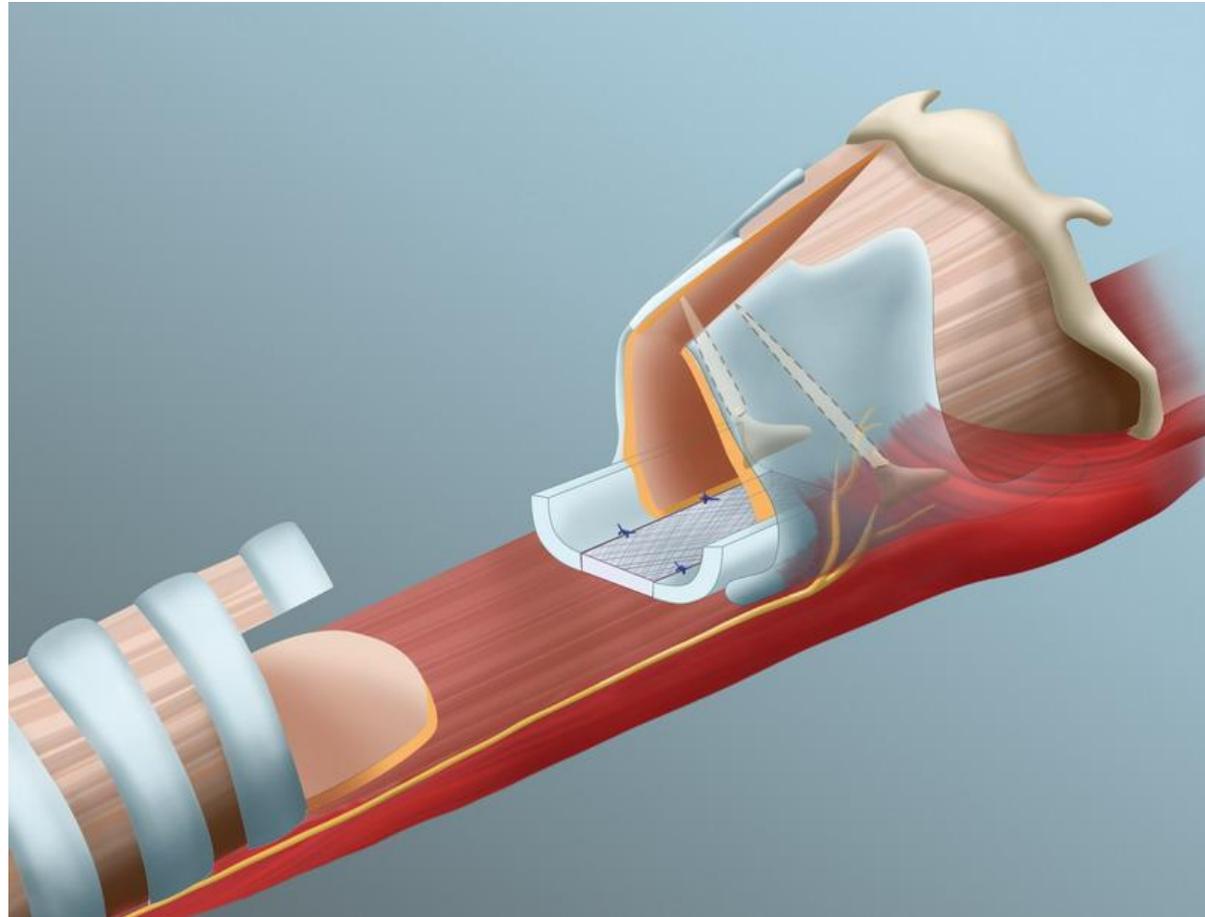


EXTENDED PCTR ③

- > Harvest of costal cartilage graft
- > Separation of cricoid laminae

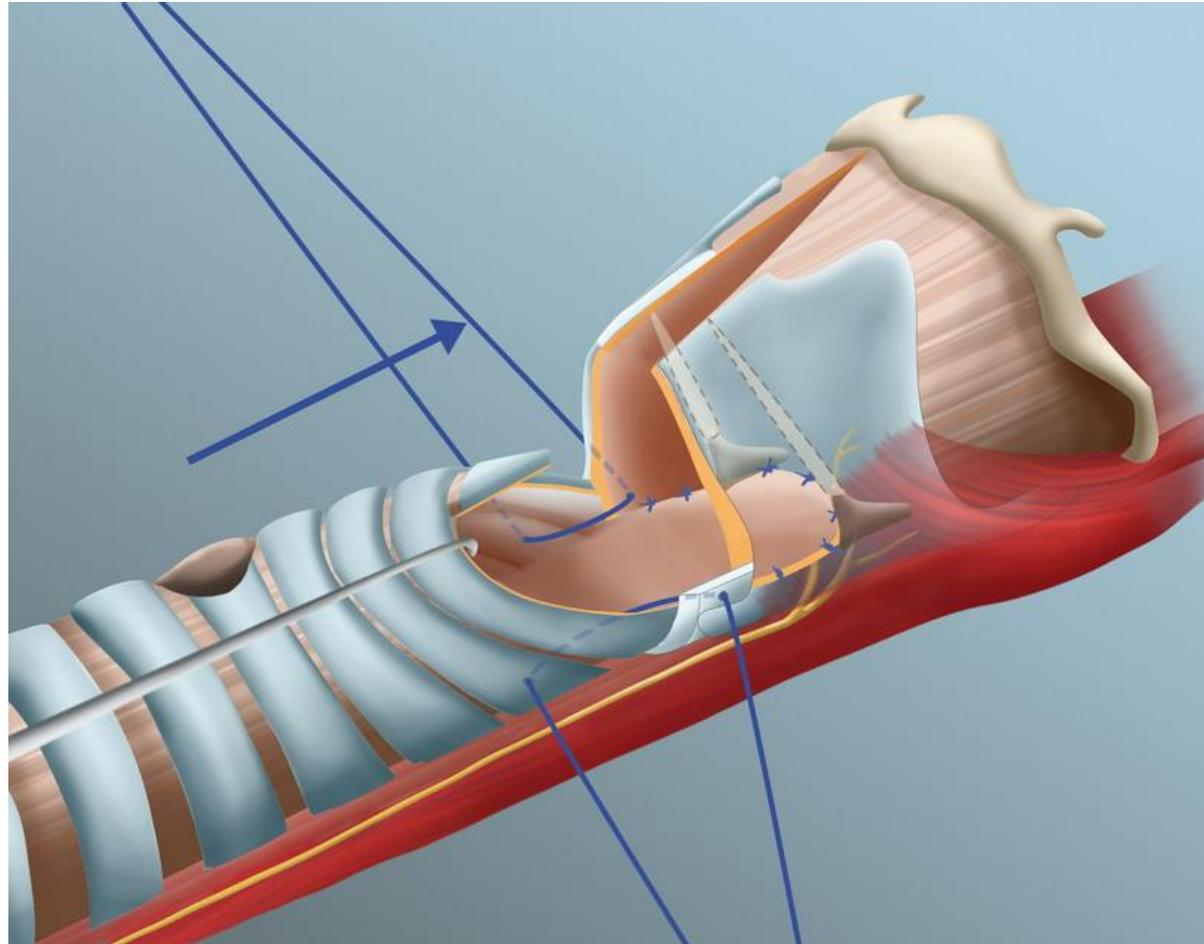


- > Suture of costal cartilage graft between the two cricoid laminae



EXTENDED PCTR ⑤

- > Cranial mobilization of tracheal stump
- > Suture of mucosal flap at posterior laryngeal commissure



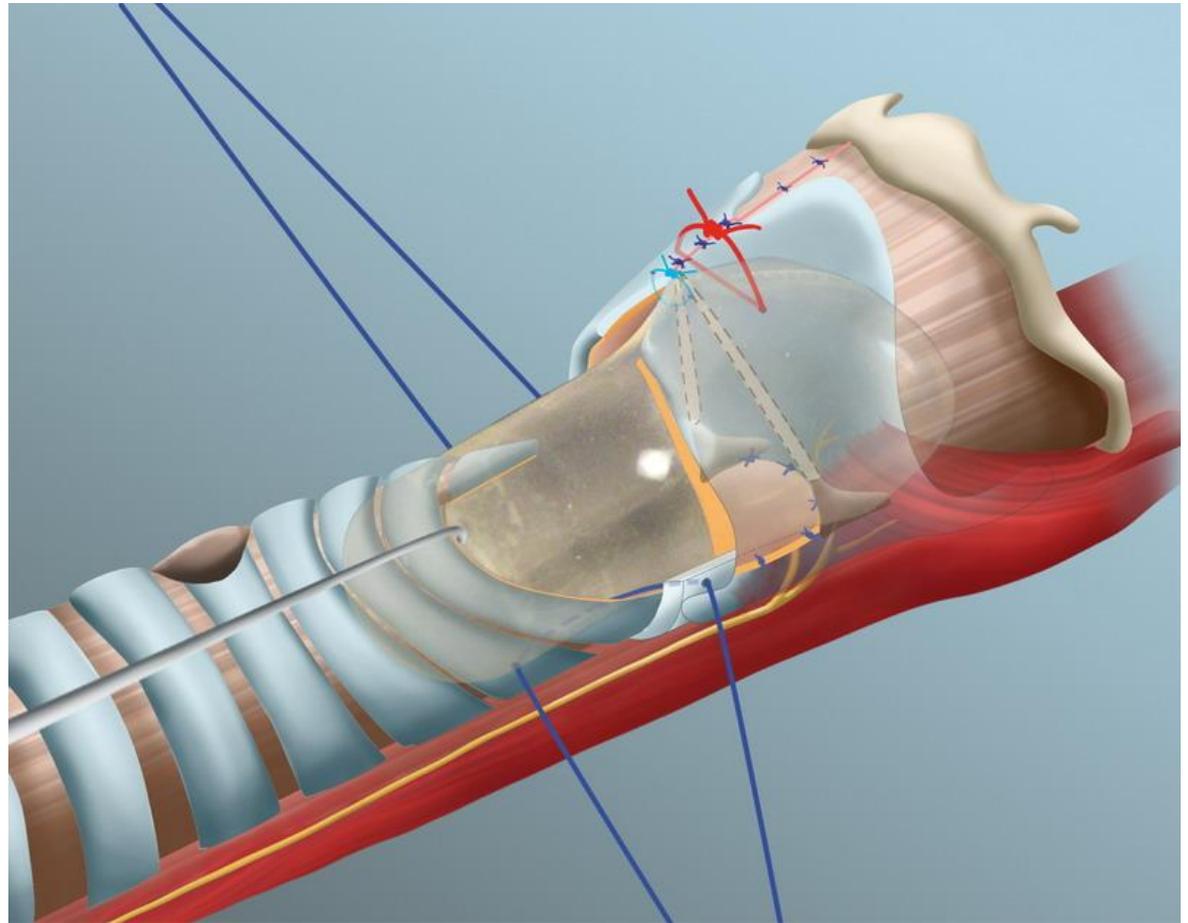
CURRENT DESIGN



4 different lengths for each size

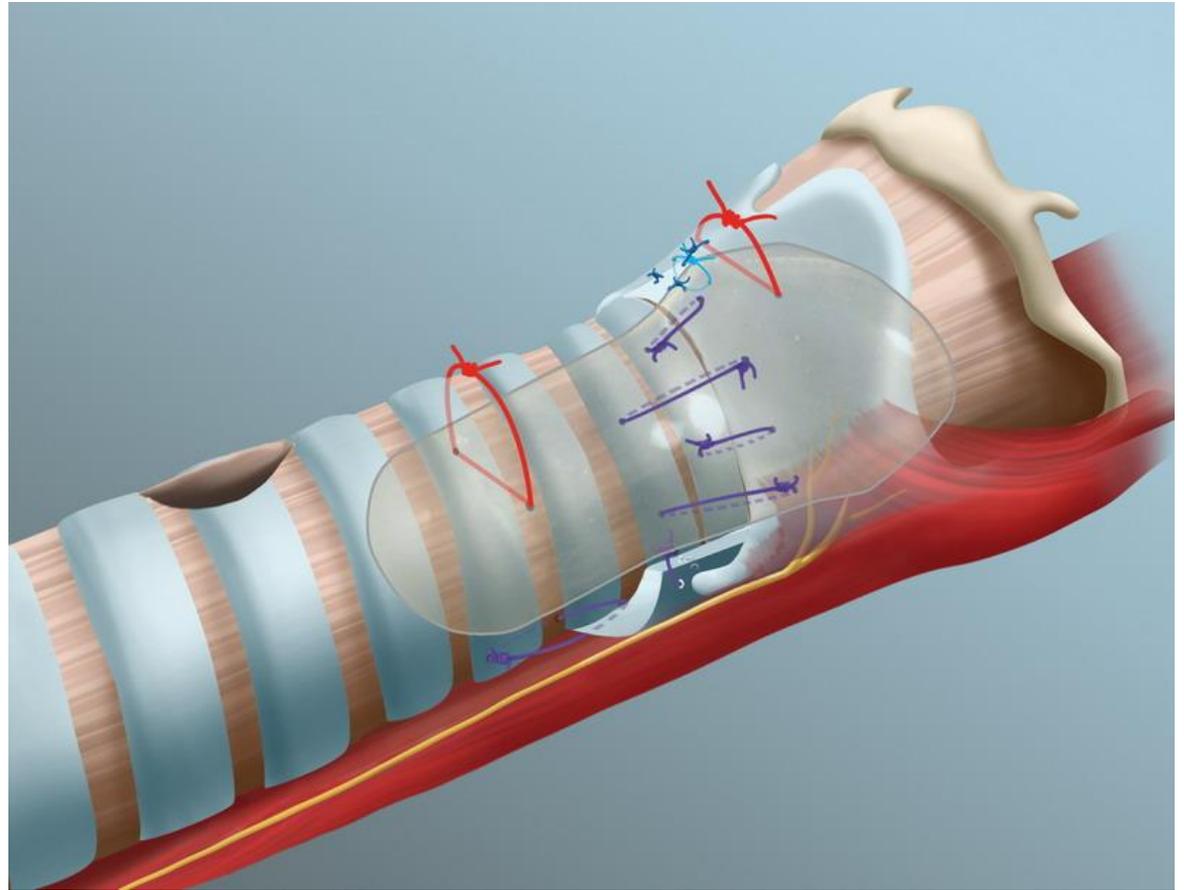
EXTENDED PCTR ⑥

- > Insertion of LT-mold in glotto-subglottic space

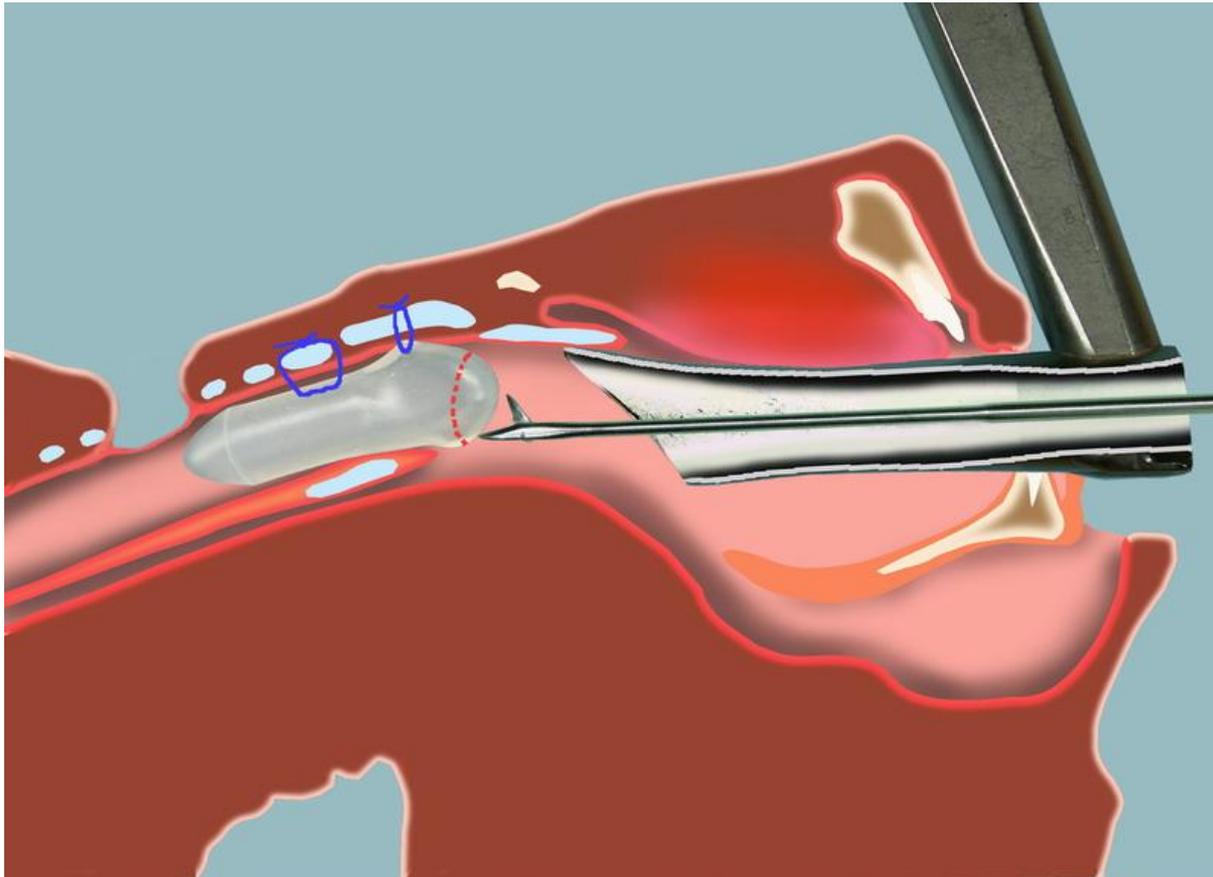


EXTENDED PCTR ⑦

- > Fixation of LT-mold
- > Closure of laryngofissure cranially to anterior commissure

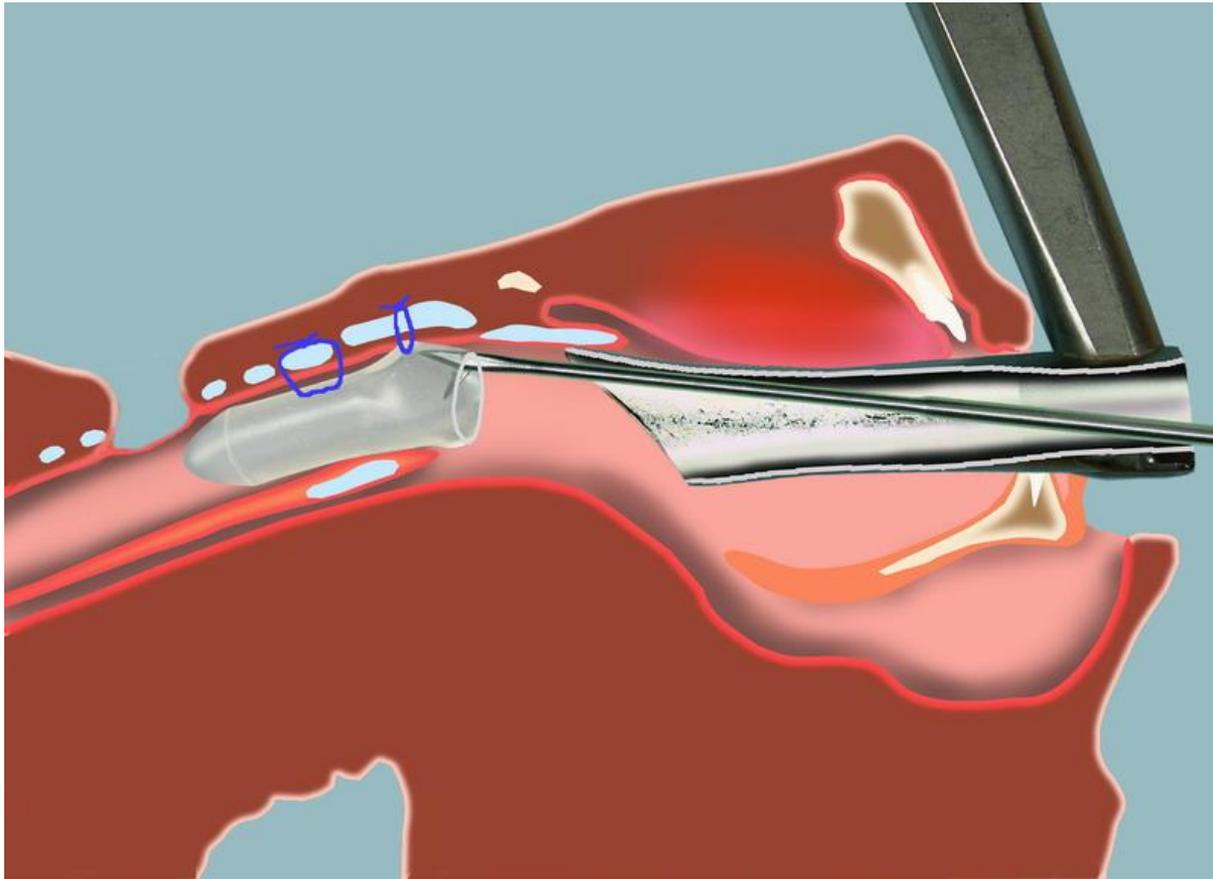


REMOVAL AFTER PEROPERATIVE FIXATION

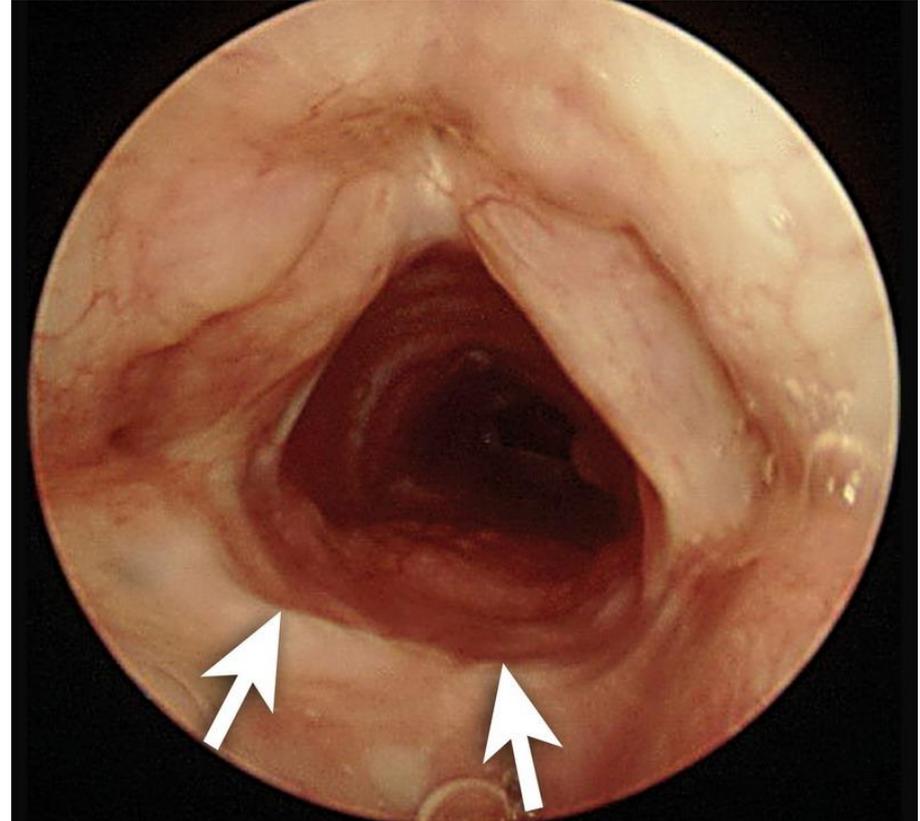
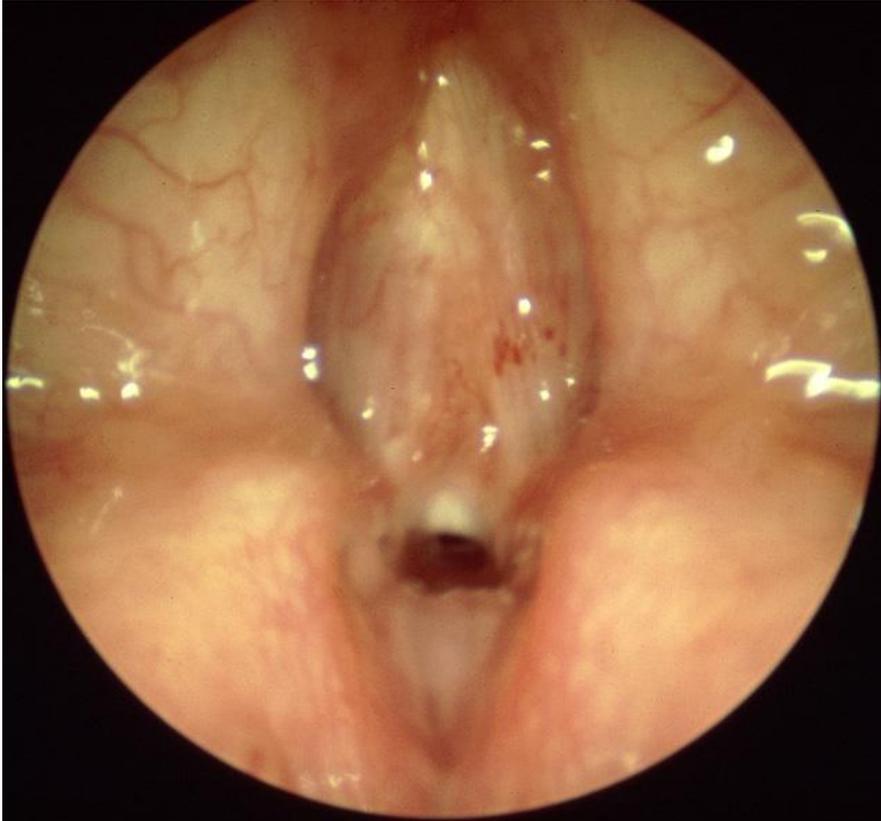


Easy LT-mold

REMOVAL AFTER PEROPERATIVE FIXATION



SGS + FUSION OF VC



RESULTS

1. Decannulation

- Time from surgery until decannulation
- Complimentary, additional procedures

2. Voice

3. Swallowing

CONCLUSION (1)

INCIPIENT
SUBACUTE POST
INTUBATION LESIONS

MATURE, CICATRICIAL
POST INTUBATION
STENOSIS



PREVENTION OF LTS

TREATMENT OF LTS



ENDOSCOPIC TTT

OPEN SURGERY

CONGENITAL



or
endoscopic surgery

CONCLUSION (2)

- Associated Synchronous airway lesions SAL's + SGS
- Precise endoscopic investigation
- Correct diagnosis & patient selection
- Selection of appropriate surgical strategy
 - > Single vs double stage

**THE BEST CHANCE
FOR THE PATIENT
LIES IN
THE FIRST OPERATION**





THE LAUSANNE COURSE

2nd edition

AIRWAY

8,9 &10 Nov. 2017

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SWITZERLAND**

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