
Larynx Cancer:

Surgical Treatment of Early Stage Disease

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Take Home Points

- Understand laryngeal anatomy and barriers to spread
- Surgical treatment methods for early stage
- Controversies

Anatomy

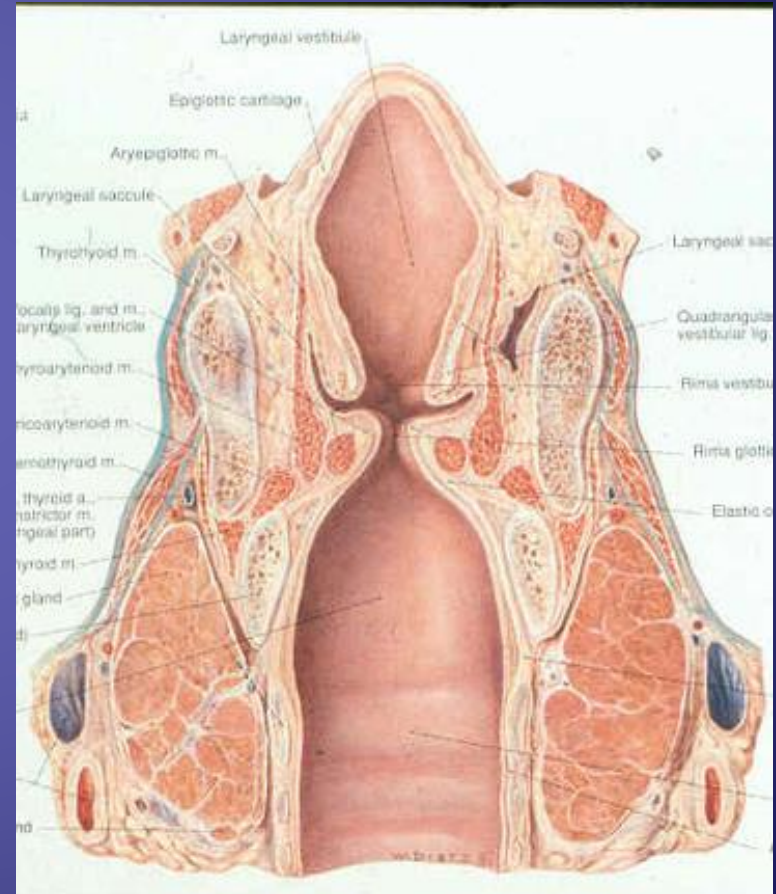
Muscles

Intrinsic

responsible for sound production and the movements of the laryngeal cartilages and folds themselves

Extrinsic

aid in the movement of the larynx at a gross level.



Anatomy

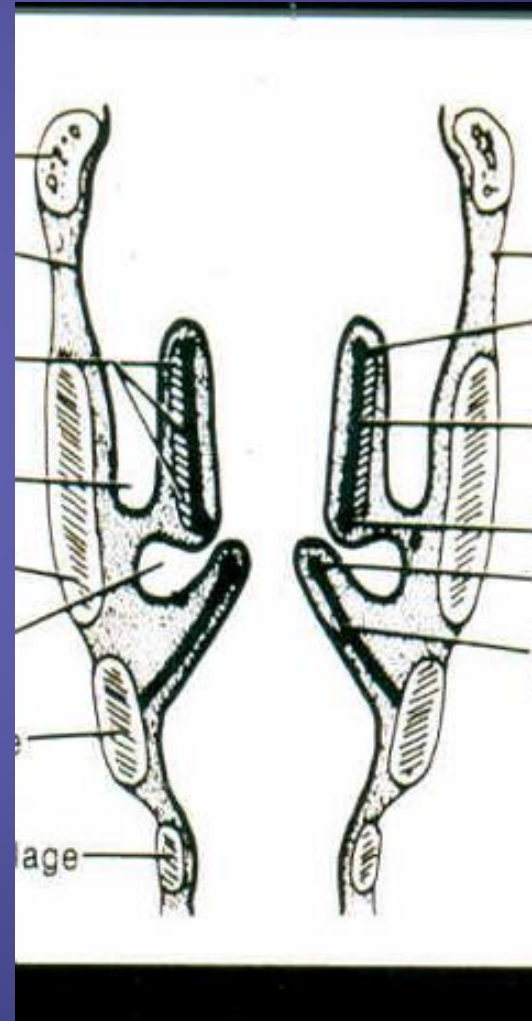
□ Membranes

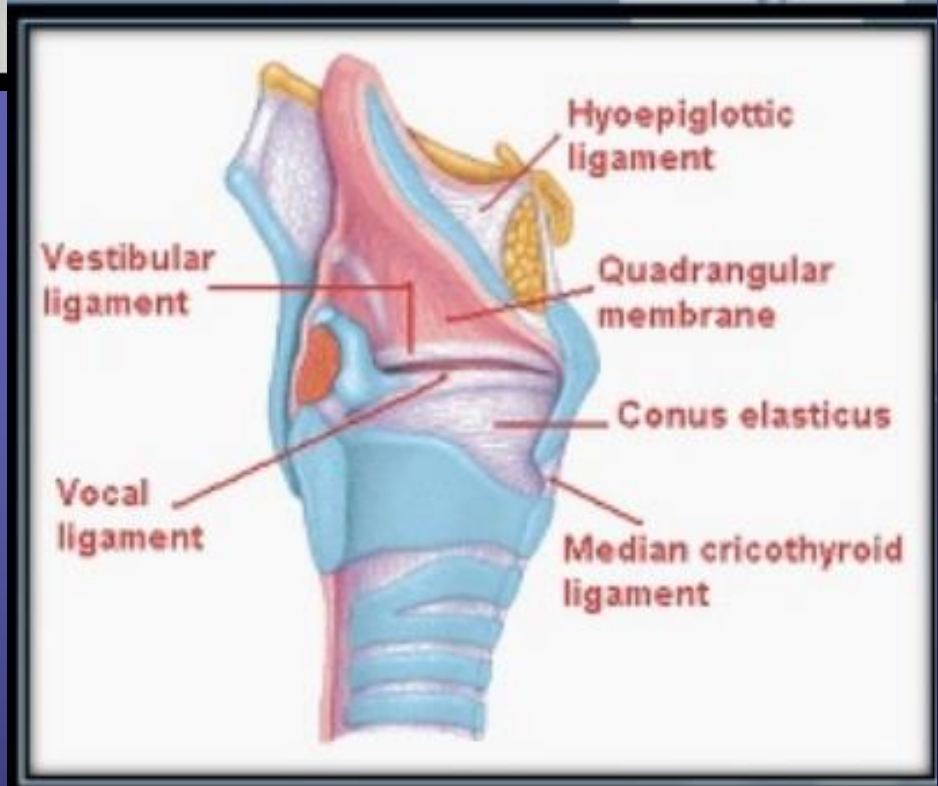
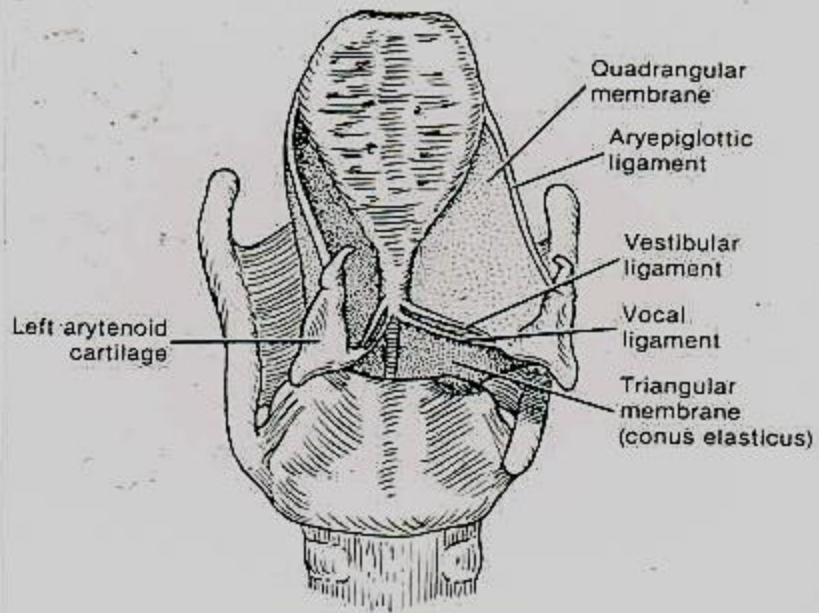
Quadrangular:

- » aryepiglottic ligament
- » vestibular ligament

Triangular membrane:

- » vocal ligament





Spread and Barriers to Spread

- Fibroelastic membranes limit spread

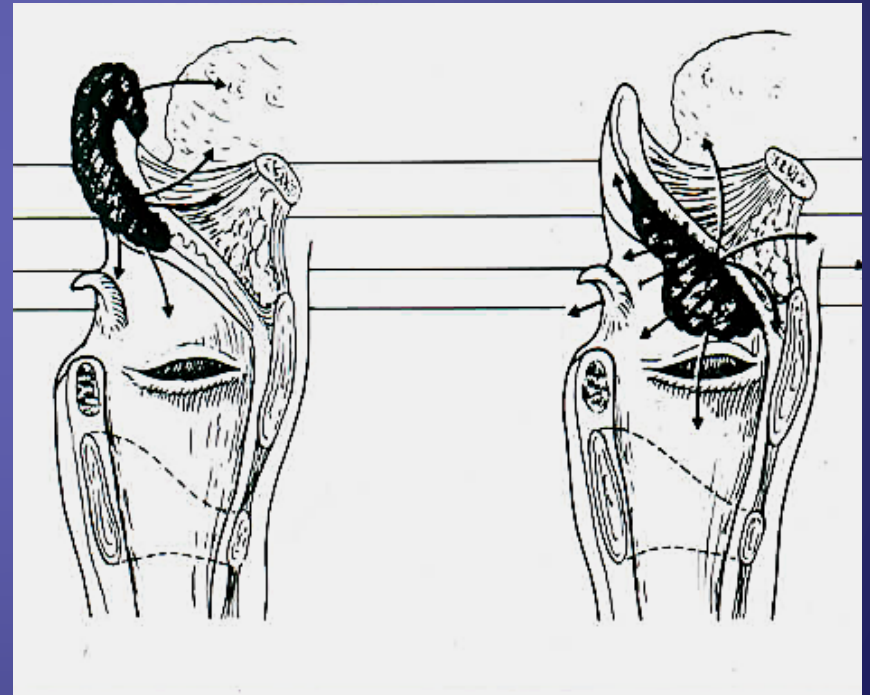
Laryngeal cancer:

- » T1 cancers limited by vocal ligament
- » impaired mobility implies TA muscle invasion
- » ossified parts preferentially invaded
- » Broyle's ligament initially is barrier

Spread and Barriers to Spread

Supraglottic Cancer

- » embryologic barrier at ventricle
- » infrahyoid tumors invade through epiglottic fenestrations
- » tends to spare thyroid cartilage



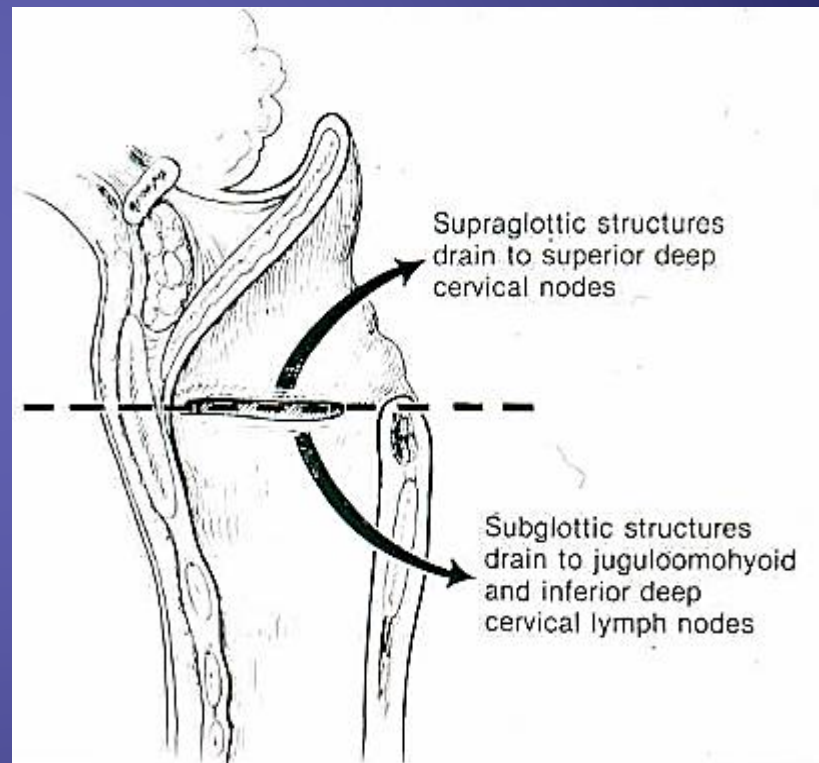
Lymphatic Spread

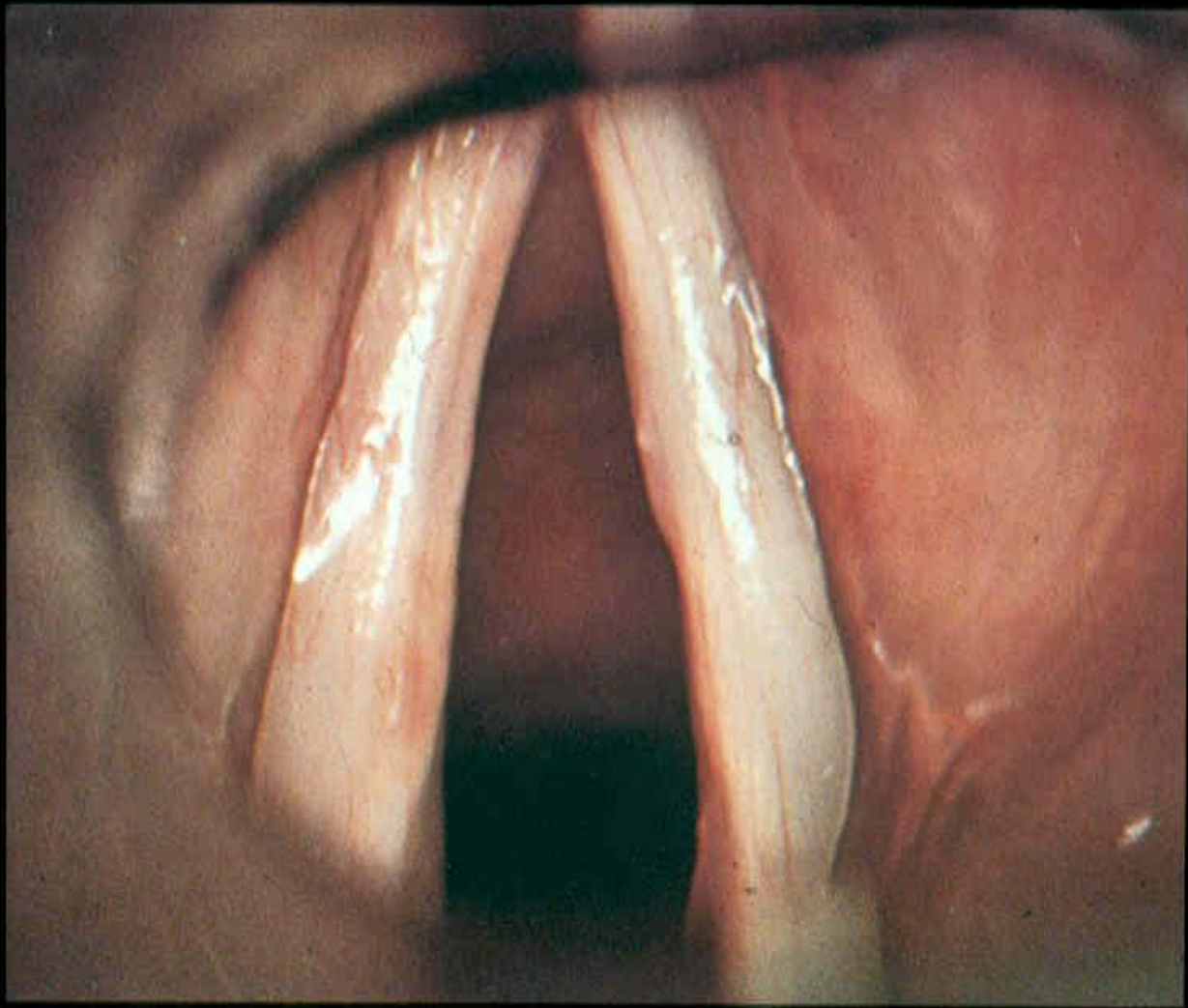
Glottic Cancer

- » rare lymph channels
- » paratracheal, III and IV
- » T1 and T2 lesions rarely produce metastatic nodes
- » mets of larger lesions depends on **supraglottic** involvement

Supraglottic

- » nodal mets are common, even in small lesions
- » levels II and III
- » high occult incidence





Malignant Tumors

- Epidemiology

Squamous cell carcinoma

Male : Female = 3-4:1

Greater prevalence in urban centers

- Cancer Statistics 2024

Est new cases 12,650 (10,030 male)

Est deaths 3,880

Malignant Tumors

□ Clinical Manifestations

Symptoms:

- hoarseness, odynophagia, cough, aspiration

Signs:

- exophytic tumor, leukoplakia, stridor, loss of laryngeal crepitation, cord fixation

Malignant Tumors

□ Diagnosis

History

- » smoking
- » Alcohol
- » Agent orange

Examination

- » assess vocal cord movement
- » laryngeal crepittance

Malignant Tumors

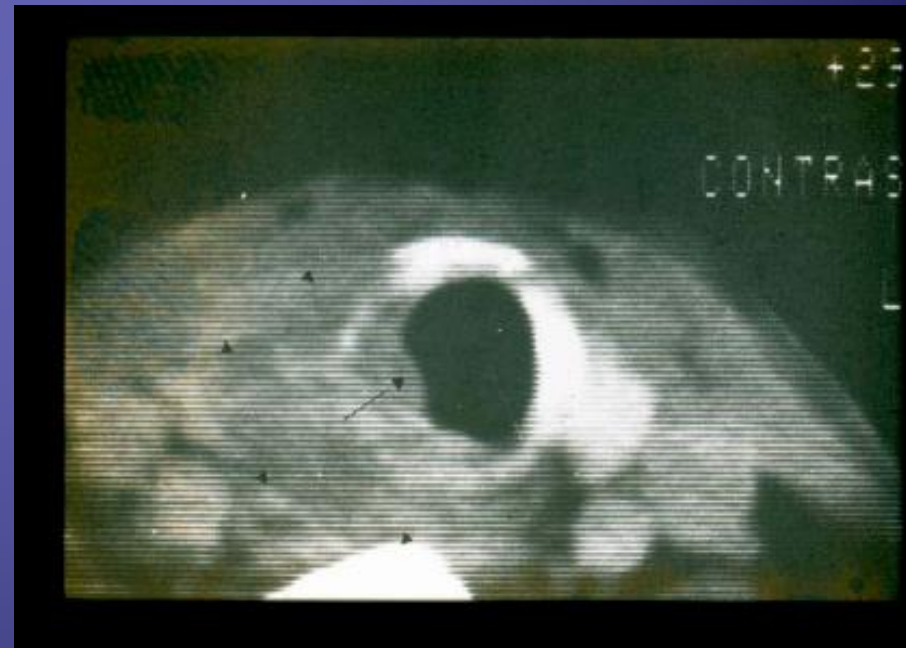
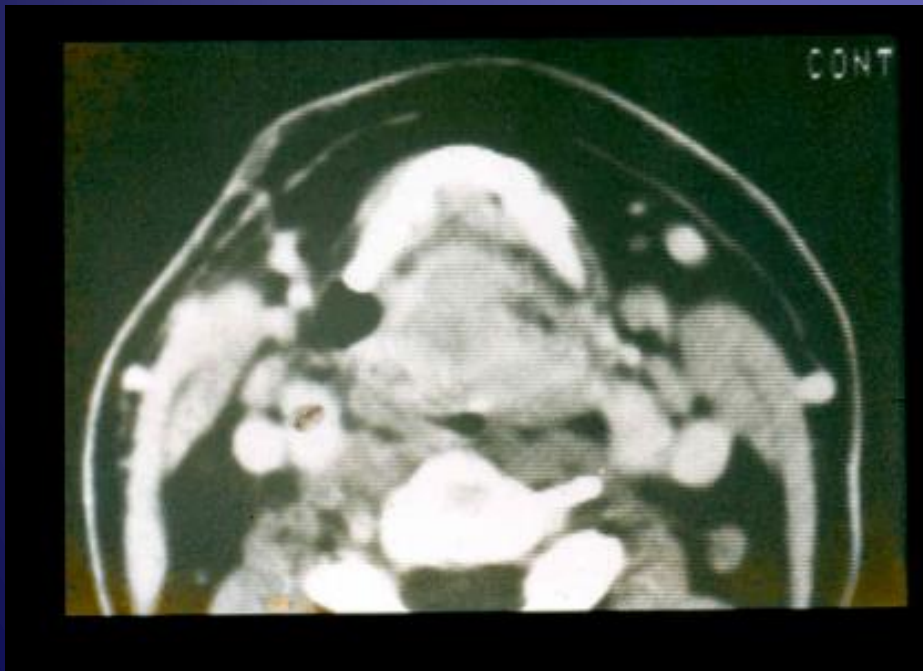
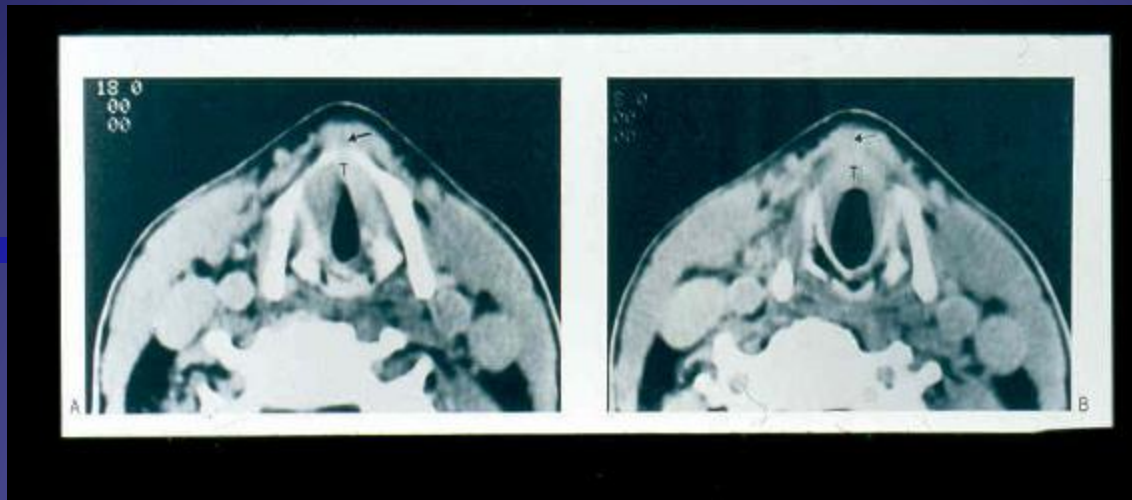
□ Diagnosis

Flexible Laryngoscopy

CT scan

- » cartilage invasion, pre-epiglottic space involvement
- » nodes, subglottic extension

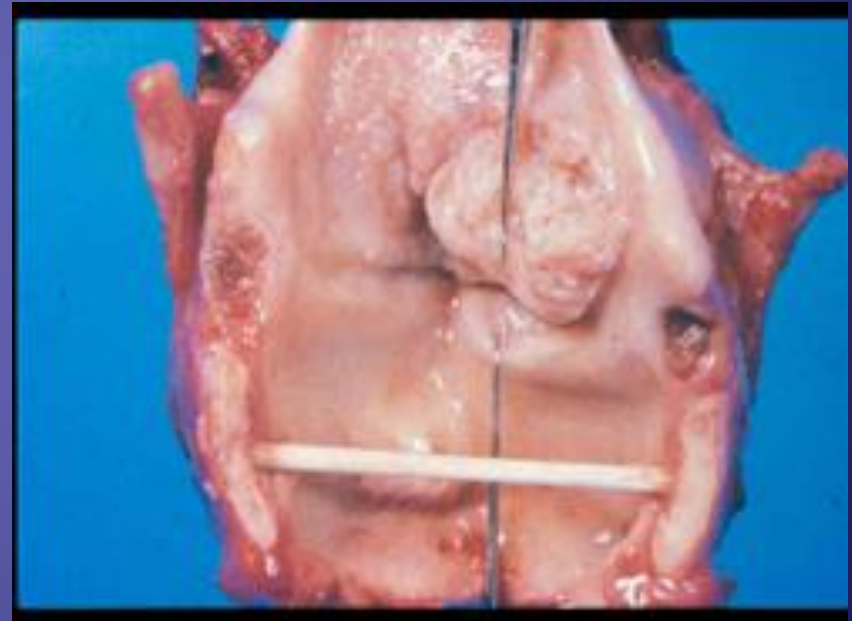




Staging Malignant Tumors

Supraglottic cancer:

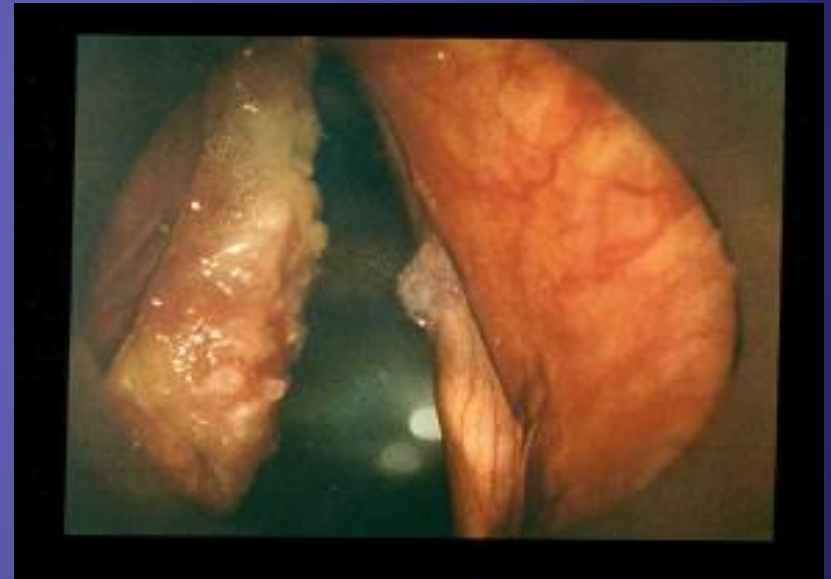
- » Subsites are FVC, a-e fold, arytenoids, epiglottis
- » **T1**: one subsite
- » **T2**: > one subsite
- » **T3**: cord fixed, piriform sinus, post-cricoid or pre-epiglottic space; inner thyroid cortex
- » **T4a**: invasion thru outer cortex thyroid cartilage, neck soft tissues
- » **T4b**: prevertebral space, encases carotid, mediastinum



Staging

Laryngeal cancer:

- » T1: one or both cords (T1a or T1b)
- » T2: extends to supra-or subglottis , and/or impaired cord mobility
- » T3: cord fixed; invasion paraglottic space; inner cortex
- » **T4a**: invasion thru outer cortex thyroid cartilage, neck soft tissues
- » **T4b**: prevertebral space, encases carotid, mediastinum



Staging Malignant Tumors

Subglottis

- » T1: limited to subglottis
- » T2: extends to cords, with or w/o impaired mobility
- » T3: cord fixed, paraglottic or inner cortex thyroid cartilage
- » T4a: invasion thru outer cortex thyroid cartilage, neck soft tissues
- » T4b: prevertebral space, encases carotid, mediastinum



Treatment

- NCCN Guidelines: www.nccn.org

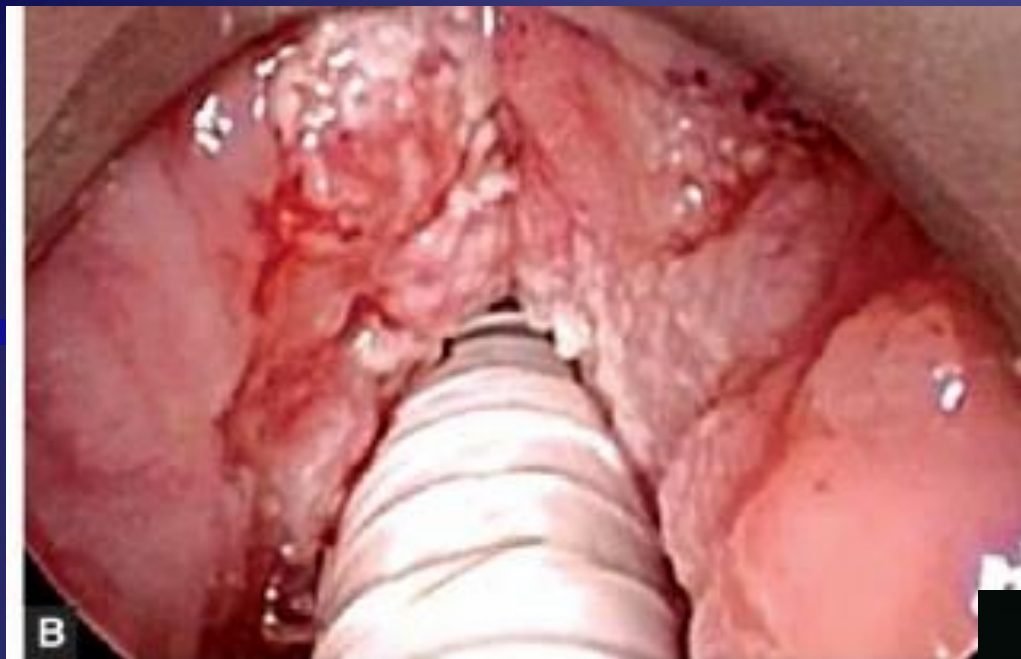


Treatment: Early Stage

- One modality!

Supraglottic cancer:

- » T1/T2 : radiation, endoscopic or
- » supraglottic laryngectomy (historical)
- » If surgery, then BSND
 - If node+, then post-op treatment
 - Must have pulmonary reserve and good rehab potential
- » If RT, then microscopic dose to bilateral neck

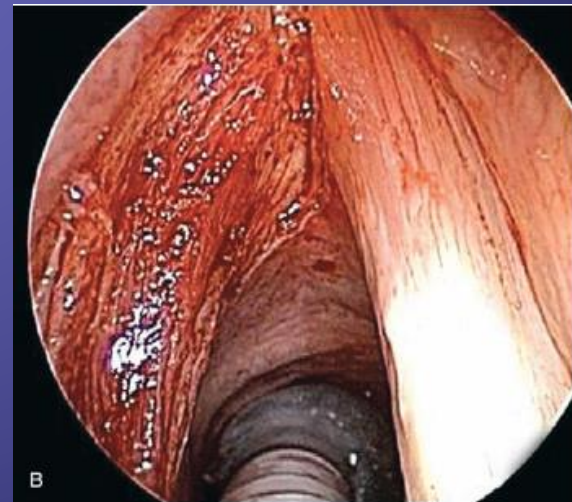
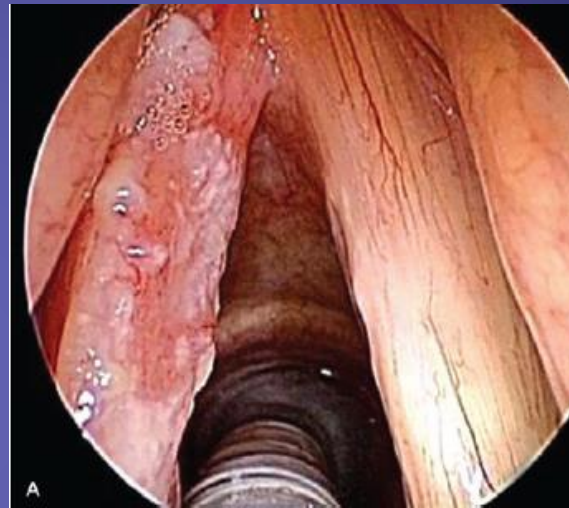


Treatment: Early Stage

Glottic cancer

- » T1/T2: radiation, transoral laser microsurgery (open hemilaryngectomy historical)

In general, RT considered better for extensive anterior or posterior commissure involvement due to risk of positive margins and suboptimal voice



Treatment: Early Stage

Demographics

- NCDB 34, 991 pts
 - 19% had surgery
 - 59% had RT
 - 23% had surgery and RT
-
- More likely to receive RT for larger tumors, tx at non-academic centers and shorter travel distance
 - Surgery more likely in Western US, higher income, private insurance, urban area, academic center female and older.
 - Education and race not associated with treatment type.

Transoral Laryngeal Microsurgery (TLM)

Definition

The piecemeal endoscopic removal of malignant tumors, using the CO2 laser under the operating microscope

History

1852: Green

1915: Lynch, Chevalier Jackson; transoral resection

1970s: Strong and Jako; CO2 laser and microscope
en bloc resection still dogma

1993: Steiner; 240 pts early stage; 6 local recurrences; 100% 5 year survival

Transoral Laryngeal Microsurgery (TLM)

Advantages

- ❑ cuts through tumor until disease-free tissue is reached and surgeon can assess the depth of invasion
- ❑ Better margin clearance
- ❑ Laser seals vessels and lymphatics
- ❑ Shorter treatment course
- ❑ A full range of salvage options
- ❑ Steiner, "Oncologically radical, but surgically less radical"

Transoral Laryngeal Microsurgery (TLM)

Who is a candidate?

- Tumors amenable to conservation laryngeal surgery
T1, T2 and some T3s
- Adequate exposure of larynx
- Palliative tumor debulking

Contraindications

- Extralaryngeal spread; inability to preserve cricoid and one arytenoid
- Inadequate exposure

Transoral Laryngeal Microsurgery (TLM)

Complications

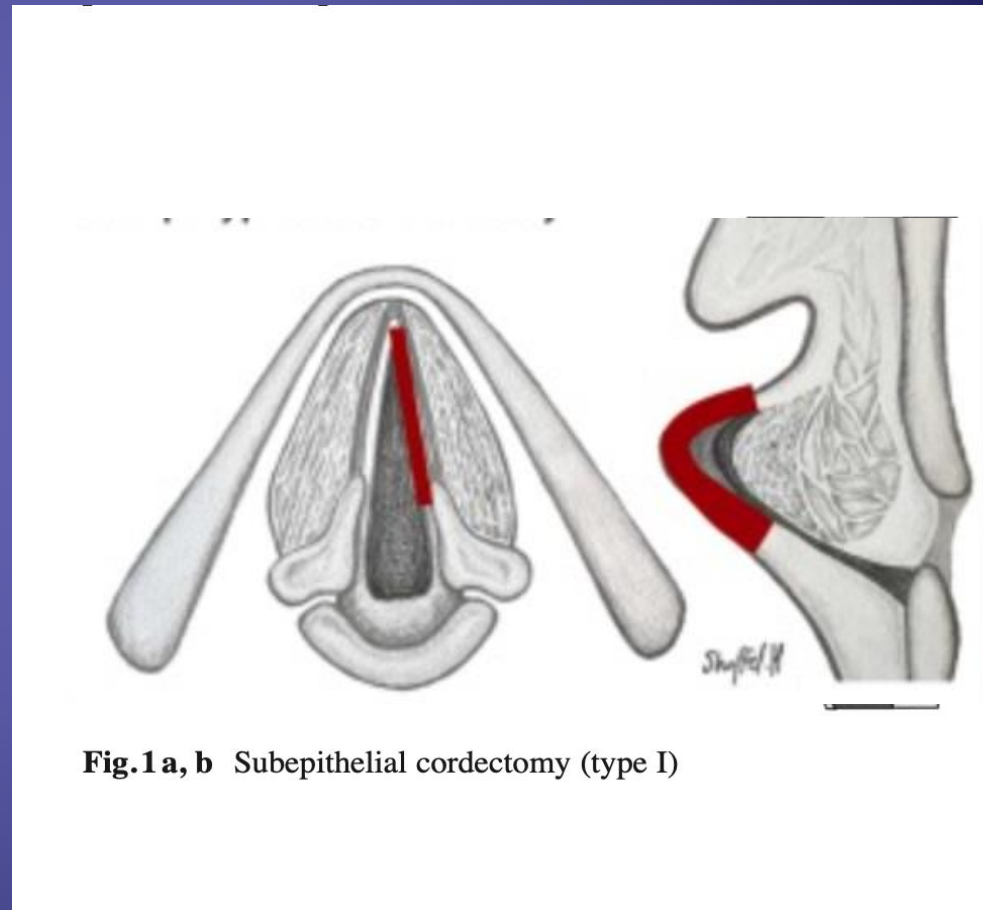
- Close or positive Margin
- Tongue weakness or numbness
- Bleeding, airway issues are rare

TLM: Cordectomy Classification

Type I: Subepithelial cordectomy

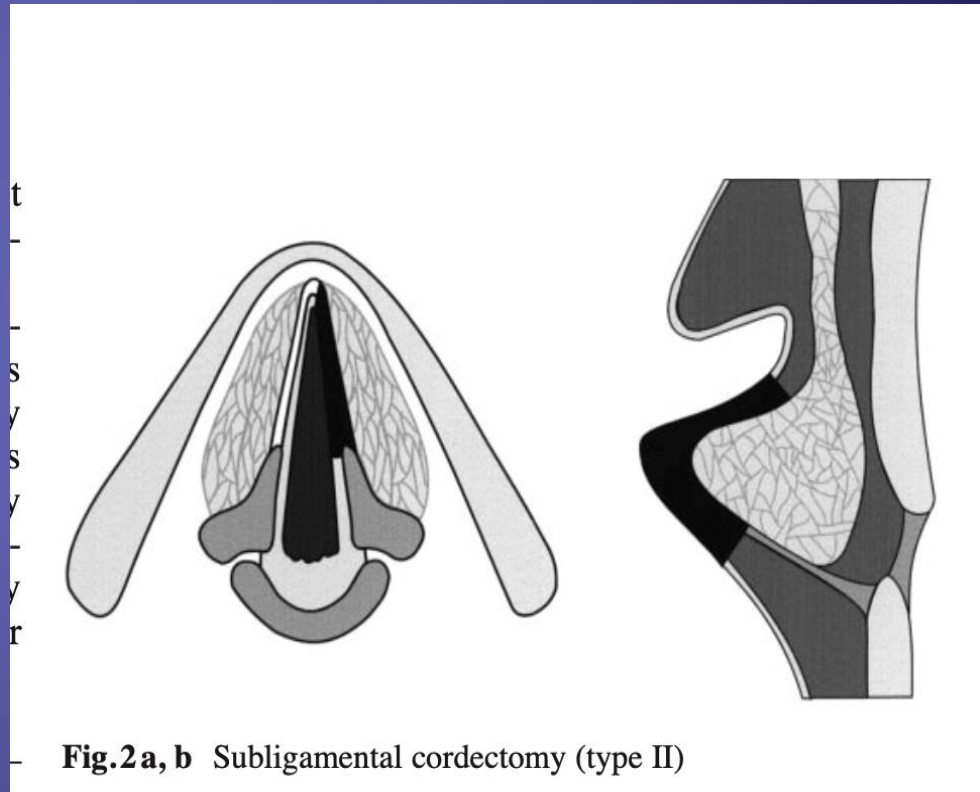
Eur Arch Otorhinolaryngol (2000) 257:
227–231

European Laryngological Society 1999



TLM: Cordectomy Classification

Type II: Subligamentary corpectomy



TLM: Cordectomy Classification

Type III:
Transmuscular
cordectomy

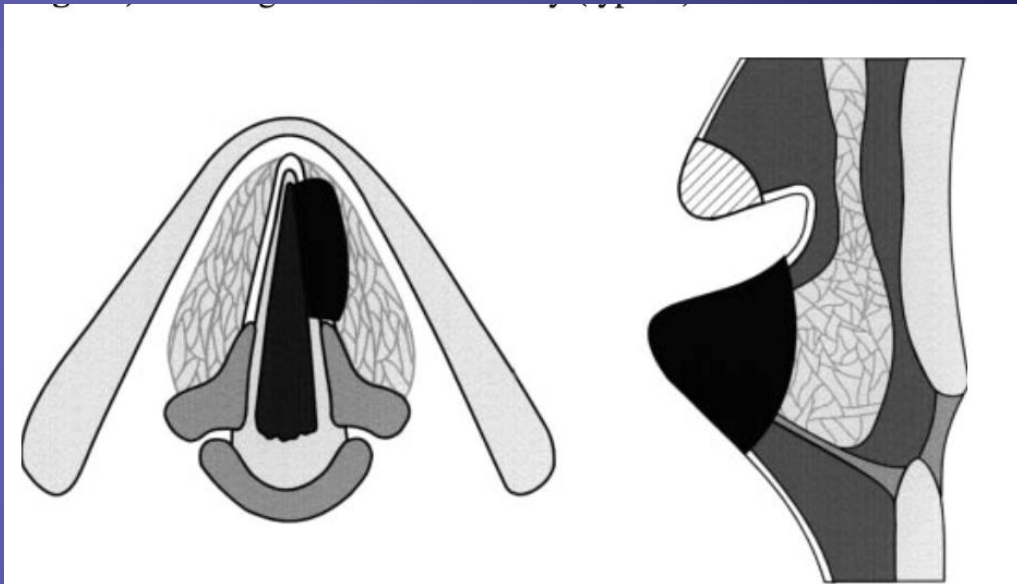


Fig.3 a, b Transmuscular cordectomy (type III). In order to expose the entire vocal fold, partial resection of the ventricular fold may be necessary (hatched area)

TLM: Cordectomy Classification

Type IV:
Complete cordectomy

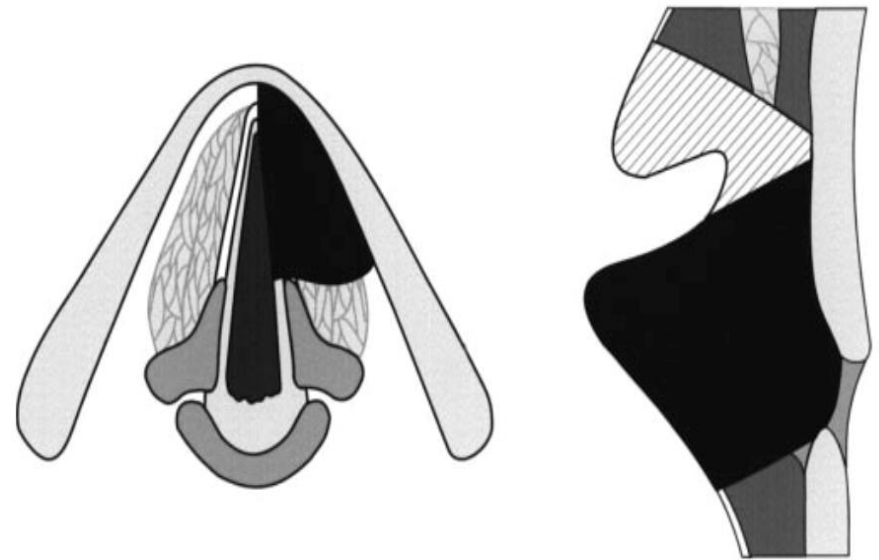
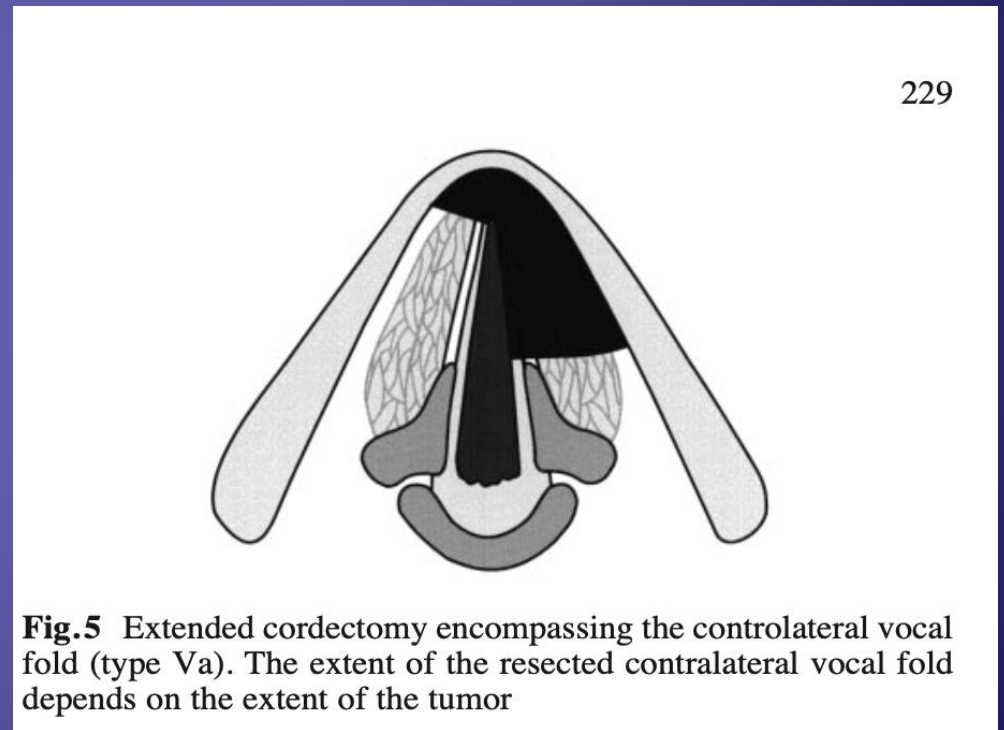


Fig.4 a, b Total or complete cordectomy (type IV). The ipsilateral ventricular fold can be removed partially or totally to ensure complete resection of the vocal fold (hatched area)

TLM: Cordectomy Classification

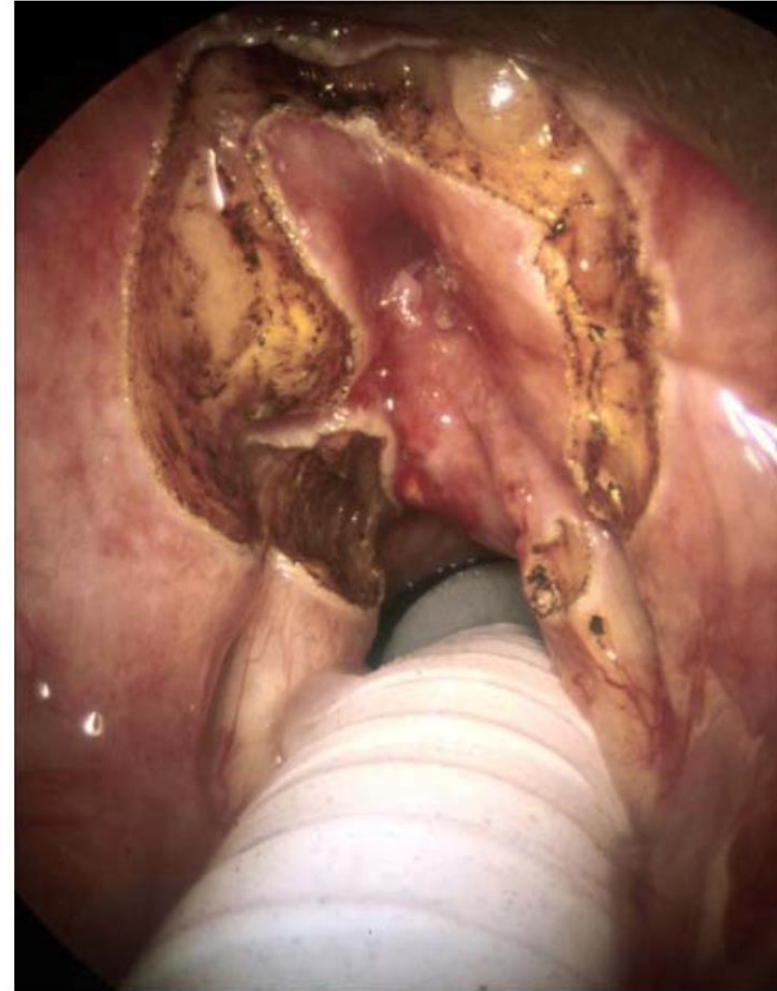
Type V: Extended
Cordectomy
(a-d)



TLM: Corpectomy Classification

Type VI:
Corpectomy
(anterior commissure)

Eur Arch Otorhinolaryngol (2007)
264:499–504



Transoral Laryngeal Microsurgery (TLM)

Oncologic Results

- 2016 Ansarin et al. (*doi 10.1002/hed.24534*)
 - 560 pts Tis-T3; 538 with TLM; 52 (8.8%) had post-op RT
 - 5 year Recurrence free survival=85.3%
 - 10 year OS 74.7%; Larynx preservation 95.9%
 - Age >60, type of cordectomy (T stage) and positive margins negatively impacts survival
- 2019 Djukic (*doi.org/10.1007/s00405-019-05453-1*)
 - 234 pts, all early stage glottis;
 - 5-year OS 92.5%; DSS= 95.3%
 - OS lower for older patients, anterior commissure involvement

Transoral Laryngeal Microsurgery (TLM)

Oncologic Results

- 2018 Hendricksma et al. Systematic review **T2 glottic lesions**
(*doi:10.1097/MOO.00438*)
 - 21 studies, 857 pts
 - Larynx preservation for T2 higher with TLM (88.8% vs 79.0%) than RT
 - Impaired cord mobility negative predictor; AC involvement NOT a negative influence
- 2021 Korkmaz (*doi.:10.1159/000519718*)
 - 161 pts, all early stage glottis;
 - 5-year OS 91.3%; DSS= 100%
 - No difference in recurrence rate with respect to AC involvement or positive surgical margins

Transoral Laryngeal Microsurgery (TLM)

Margins

- What is a good margin? (0.5mm-3mm)
- What do do about positive margins?
 - Second look in 30 days to 10 weeks?
 - Radiation?
 - Wait and see?

Transoral Laryngeal Microsurgery (TLM)

Compared to Radiation (no RCTs)

Doluaglu 2024; (*doi 10.5144/0256-1947*)

261 pts; OS TLM 85.9 vs RT 74.3% $p=.034$)

AC involvement prognostic factor for both TLM and RT

Vaculik 2019 systematic review T1 glottic lesions
(*doi:10.1186/s40463-019-0367-2*); 16 studies ;1017 TLM, 970 RT pts

OS odds ratio TLM 1.52; $p=0.02$

DSS odds ratio 2.7; $p=0.007$

Lx Preservation OR 6.31; $p<0.00001$

TLM superior method; no difference in local recurrence

Transoral Laryngeal Microsurgery (TLM)

Functional Results

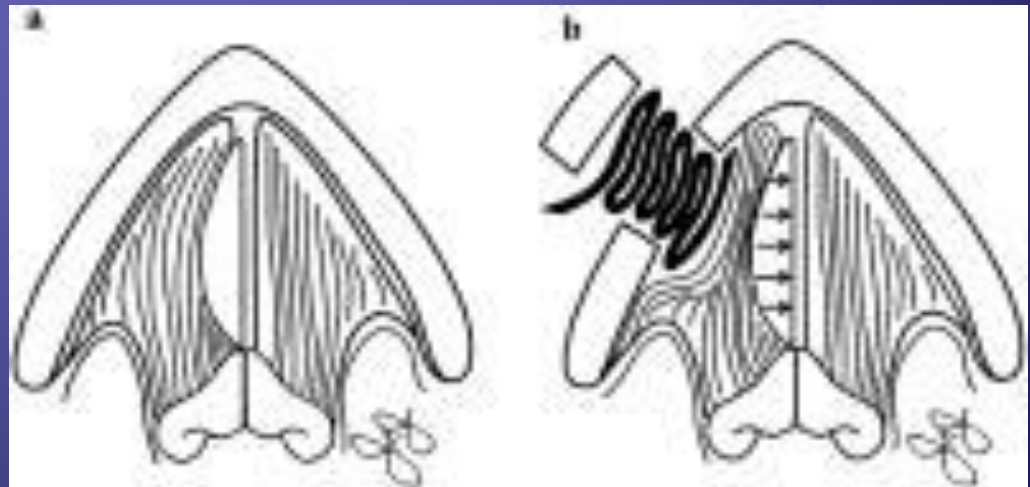
- Cordectomy I-III have similar to improved voice after healing; larger resections and AC resections have poorer outcomes
- Similar voice outcomes compared to RT
- Understand optimal time of return which may be up to 2 years

TLM

Adjunct Procedures

Phonosurgical reconstruction of early Glottic Cancer – Zeitels

- ▣ Laryngoplasty – silastic, Gortex

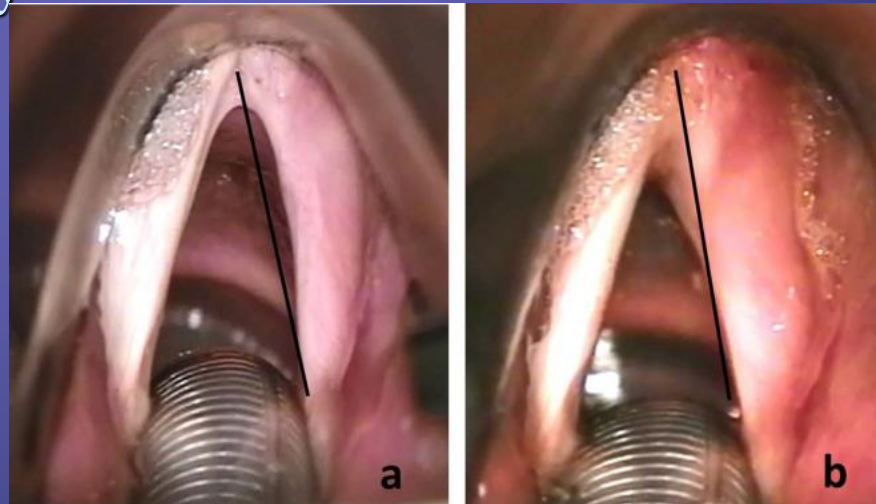


Transoral Laryngeal Microsurgery (TLM)

Adjunct procedures

Bertelson, Reder 2018 (doi 10.1002/lary.26877)

Thyroplasty is beneficial option; improved subjective and objective voice quality



Zapater E, Oishi N, Hernández R, Basterra J. Medialization thyroplasty under intubation anesthesia to restore the voice after cordectomy. *Laryngoscope*. 2016 Jun;126(6):1404-7. doi: 10.1002/lary.25600. Epub 2015 Sep 15. PMID: 26372050

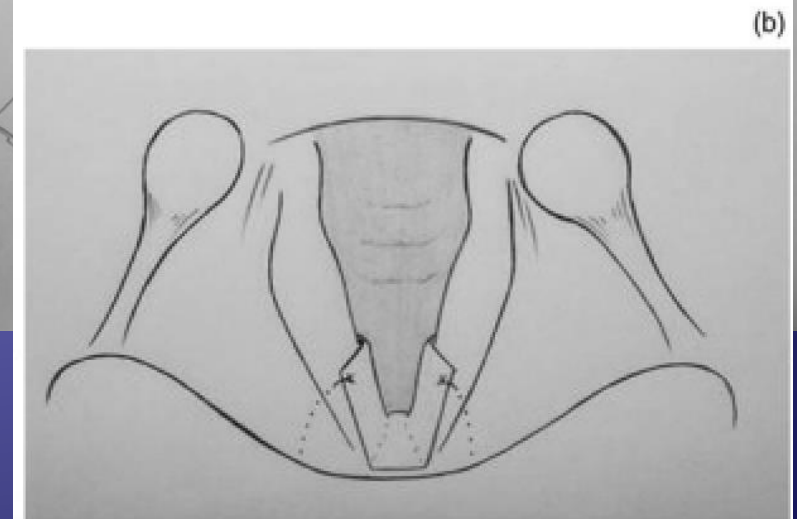
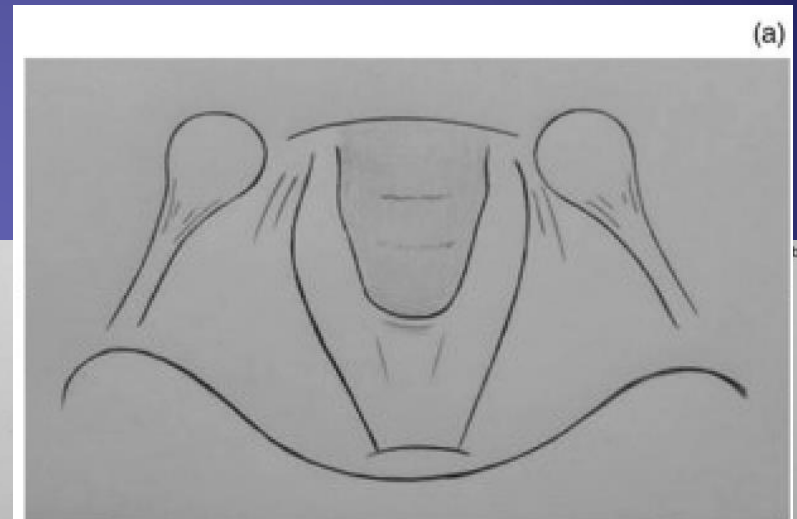
Transoral Laryngeal Microsurgery (TLM)

Adjunct procedures

Anterior Commissure Web

- Mitomycin C not recommended
- Staged resections
- keel

Fussey JM, Borsetto D, Pelucchi S, Ciorba A. Surgical management of acquired anterior glottic web: a systematic review. *J Laryngol Otol.* 2019 Oct;133(10):867-874. doi: 10.1017/S0022215119001920. Epub 2019 Sep 18. PMID: 31530291.



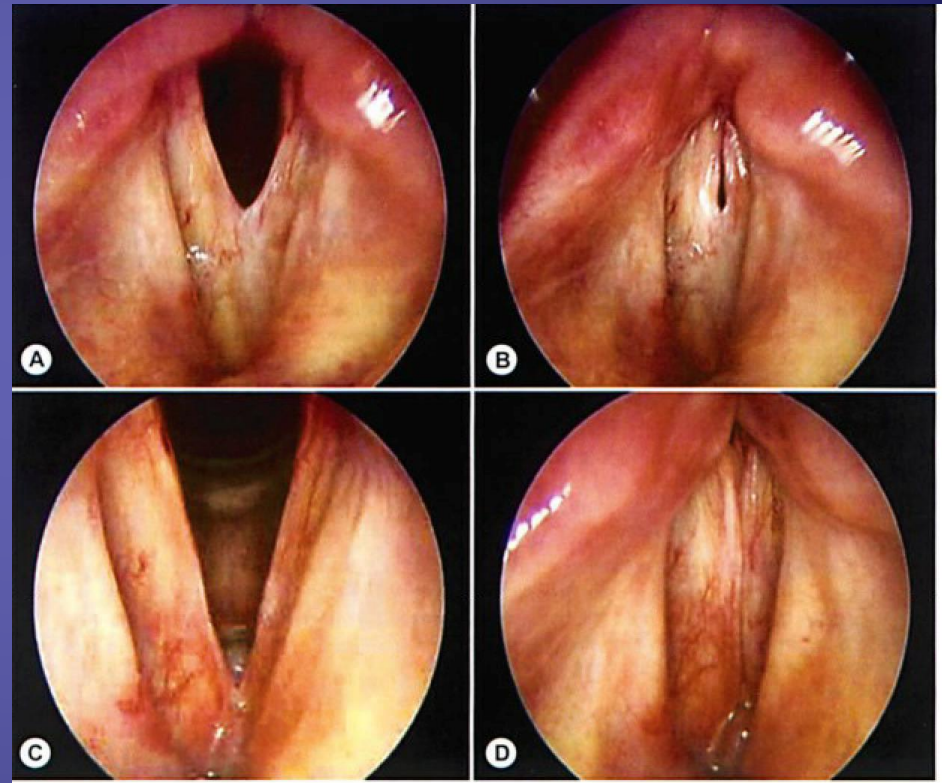
Transoral Laryngeal Microsurgery (TLM)

Adjunct procedures

Anterior Commissure Web

Laser treatment of web with
creation of a long “alley” at inner
perichondrium; acts like a keel

Su CY, Alswiahb JN, Hwang CF, Hsu CM, Wu PY, Huang HH.
Endoscopic laser anterior commissurotomy for anterior
glottic web: one-stage procedure. *Ann Otol Rhinol Laryngol.*
2010 May;119(5):297-303. doi:
10.1177/000348941011900505. PMID: 20524574.



Early Stage Laryngeal Cancer; Studies

- Early laryngeal cancers: RT vs surgery
 - Theory = RT is better at anterior commissure
 - Not so, say Steiner and Pearson

McGuirt 1994: voice is similar when selected patients undergo laser resection

Van-deLeeuw 1999: voice not *normal* after RT

Swisher –McClure 2014: small increase in CVA

Early Stage Summary

Factors

Size, extent, location, clinician's experience, pts preference, pulmonary status and rehab potential, logistical issues and pt compliance;

Cost

Laser Surgery \$2000-\$4000;

Medialization laryngoplasty: \$3,846–\$6,665

Radiotherapy \$4500- \$50,000

Cost-minimisation and cost-effectiveness analysis comparing transoral CO₂ laser cordectomy, laryngofissure cordectomy and radiotherapy for the treatment of T1-2, No, M0 glottic carcinoma

[10.1007/s00405-012-2139-8](https://doi.org/10.1007/s00405-012-2139-8)



Hendriksma, Martine; Heijnen, Bas J.; Sjögren, Elisabeth V.. Oncologic and functional outcomes of patients treated with transoral CO2 laser microsurgery or radiotherapy for T2 glottic carcinoma: a systematic review of the literature. *Current Opinion in Otolaryngology & Head and Neck Surgery* 26(2):p 84-93, April 2018. | DOI: 10.1097/MOO.0000000000000438

Kinshuck AJ, Shenoy A, Jones TM. Voice outcomes for early laryngeal cancer. *Curr Opin Otolaryngol Head Neck Surg.* 2017 Jun;25(3):211-216. doi: 10.1097/MOO.0000000000000363. PMID: 28277333.

Piazza C, Paderno A, Grazioli P, Del Bon F, Montalto N, Perotti P, Morello R, Filauro M, Nicolai P, Peretti G. Laryngeal exposure and margin status in glottic cancer treated by transoral laser microsurgery. *Laryngoscope.* 2018 May;128(5):1146-1151. doi: 10.1002/lary.26861. Epub 2017 Sep 12. PMID: 28895157.

Vaculik MF, MacKay CA, Taylor SM, Trites JRB, Hart RD, Rigby MH. Systematic review and meta-analysis of T1 glottic cancer outcomes comparing CO₂ transoral laser microsurgery and radiotherapy. *J Otolaryngol Head Neck Surg.* 2019 Sep 3;48(1):44. doi: 10.1186/s40463-019-0367-2. PMID: 31481120; PMCID: PMC6724253.

Liu CH, Chien PJ, Hung LT, Wang LM, Kao YC, Tsai YJ, Chu PY. Long-term Oncologic Results and Voice Outcomes in Patients With Glottic Cancer After Modified Type III Cordectomy. *Otolaryngol Head Neck Surg.* 2022 Nov;167(5):839-845. doi: 10.1177/01945998221075317. Epub 2022 Feb 15. PMID: 35167384.

Colizza A, Ralli M, D'Elia C, Greco A, de Vincentiis M. Voice quality after transoral CO₂ laser microsurgery (TOLMS): systematic review of literature. *Eur Arch Otorhinolaryngol.* 2022 Sep;279(9):4247-4255. doi: 10.1007/s00405-022-07418-3. Epub 2022 May 3. PMID: 35505113; PMCID: PMC9363323.

Kerr P, Mark Taylor S, Rigby M, Myers C, Osborn H, Lambert P, Sutherland D, Fung K. Oncologic and voice outcomes after treatment of early glottic cancer: transoral laser microsurgery versus radiotherapy. *J Otolaryngol Head Neck Surg.* 2012 Dec;41(6):381-8. PMID: 23700582.

Fink DS, Sibley H, Kunduk M, Schexnaildre M, Kakade A, Sutton C, McWhorter AJ. Subjective and objective voice outcomes after transoral laser microsurgery for early glottic cancer. *Laryngoscope.* 2016 Feb;126(2):405-7. doi: 10.1002/lary.25442. Epub 2015 Nov 24. PMID: 26597360.

Tracy LF, Hron TA, Van Stan JH, Burns JA. Wound healing after transoral angiolytic laser surgery for early glottic carcinoma. *Laryngoscope.* 2019 Feb;129(2):435-440. doi: 10.1002/lary.27283. Epub 2018 Sep 8. PMID: 30194756.

Sittel C, Friedrich G, Zorowka P, Eckel HE. Surgical voice rehabilitation after laser surgery for glottic carcinoma. *Ann Otol Rhinol Laryngol.* 2002 Jun;111(6):493-9. doi: 10.1177/000348940211100604. PMID: 12090704.

Zapater E, Oishi N, Hernández R, Basterra J. Medialization thyroplasty under intubation anesthesia to restore the voice after cordectomy. *Laryngoscope.* 2016 Jun;126(6):1404-7. doi: 10.1002/lary.25600. Epub 2015 Sep 15. PMID: 26372050.

Cristalli G, Vidiri A, Mercante G, Ferrel F, De Virgilio A, Donelli F, Davì L, Gasparin P, Cocco P, Giudici F, Boscolo Nata F. Radiological Findings in Laryngeal Anterior Commissure Invasion: CT Scan Highlights. *Laryngoscope.* 2022 Dec;132(12):2427-2433. doi: 10.1002/lary.30060. Epub 2022 Feb 15. PMID: 35166380.

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Vlastarakos PV, Georgantis I, Nikolopoulos TP, Delidis A. Revisiting the Concept of Non- and Minimally Invasive Interventions in Early Glottic Cancer - Part II: Single Therapy Should be Favored over the Combination of Transoral Laser Microsurgery and Radiotherapy, Regarding the Postinterventional Voice Quality. *Int Arch Otorhinolaryngol*. 2021 Aug 13;26(3):e310-e313. doi: 10.1055/s-0041-1730454. PMID: 35846809; PMCID: PMC9282953.





