CANCER OF THE HEAD AND NECK

HEAD AND NECK CANCERS (HNC) - cancers of the upper aerodigestive tract

SUBSITES
- Lips
- Oral cavity
- Oropharynx
- Sinonasal cavities (PNS + NP)
- Larynx
- Hypopharynx
- Salivary glands

EPIDEMIOLOGY - Men > Women (70% M – 30% F)
- Dx > 40y, except salivary & Nasopharyngeal Ca → younger age

ETIOLOGY

1) TOBACCO - Smoked - Cigarettes, Bidis, Cigars, Pipes, Cheroot, second-hand exposure
Smokeless - Chewing, Moist snuff, Dry snuff, Betel quid, Gutkha, Zarda

Cigarette smokers - 5-25 fold ↑ risk

[Relative risk ↑ c̄ duration, becomes equal to non smokers only after ~20y cessation]

2) Alcohol - independent risk factor for oral, pharyngeal & laryngeal Ca
≥ 3.5 drinks/day → ↑ risk 2-3 fold

TOBACCO & ALCOHOL have synergistic effects (↑ Risk multiplicative rather than additive)
+ POOR DIET

FIELD CANCERIZATION - Slaughter - explains development of multiple primary tumors and recurrent local tumors - genetically altered epithelium in the vicinity of the tumor - ↑ risk of developing a 2nd tumor

✓ **SECOND PRIMARY TUMOR**

Tumor which develops ≥ 2cm away from the index tumor after ≥ 3y from the first malignancy (WARREN/GATES criteria)

- i.e., 2 tumors must be distinct
- Possibility of 2nd tumor being metastasis of the 1st must be excluded
- genetic markers different

2nd primary may develop in H & N or elsewhere (eg. Esophagus/Lung)

✓ **SECOND FIELD TUMOR**

Second tumor derived from the same genetically altered mucosal field as the primary tumor

- genetic markers similar

3) HPV infection (HPV-16) - Oropharyngeal cancer

4) EBV infection - Nasopharyngeal cancer

5) Occupational exposures - asbestos, pesticides, wood, leather, cement, formaldehyde, etc

6) Immunosuppression - HIV/organ transplant

7) Li-fraumeni S°, Fanconi anemia, Plummer Vinson S°

MOLECULAR BIOLOGY

- p53 mutations
- CDKN2A mutation
- EGFR amplification
- Microsatellite instability

HPV- E6, E7 proteins
↓
p16 (Tumor suppressor gene)
→ Overexpression of p16 is a surrogate marker for HPV infection

HISTOLOGY

- Most head & neck neoplasms arise from the surface epithelium

SCC OR its VARIANTS

Lymphoepithelioma - SCC + lymphoid stroma : Nasopharynx, BOT, Tonsillar fossa
Spindle cell carcinoma - resembles sarcoma + SCC
Verrucous carcinoma - low grade SCC - gingiva, buccal mucosa
Undifferentiated carcinoma

- Adenocarcinomas - Salivary gland tumors
- Lymphomas - NHL

SPREAD

Bone, mucoperiosteum, cartilage - barriers to invasion - involvement is late
Tumor extension into parapharyngeal space - allows superior & inferior spread from SKULL BASE TO HYOID BONE
Perineural invasion - SCC, Adenoid cystic Carcinoma

LYMPHATIC SPREAD

- There are no capillary lymphatics in the epithelium
- Tumor must penetrate lamina propria before lymphatic invasion can occur

Nasopharynx & Pyriform sinus - most profuse capillary lymphatics

Lip, oral cavity → I, II → other levels

Laryngeal & Pharyngeal tumors - II - III → other levels

Distant spread - Lung m/c

STAGING AJCC-8 for Head & Neck Cancer (Excluding Nasopharynx & p16⊖ Oropharyngeal cancer)

T

- T_x - cannot be assessed
- T_{is} - in situ
- T_1 - size ≤ 2cm
- T_2 - 2-4 cm
- T_3 >4 cm
- T_4
  - T_{4a} - invades adjacent structures
  - T_{4b} - invades masticator space/pterygoid plates, skull base / encases ICA

N

- N_x - cannot be assessed
- N_0 - no regional LN mets
- N_1 - single, ipsilateral node ≤ 3cm
- N_2
  - N_{2a} - single, ipsilateral node 3-6cm
  - N_{2b} - multiple ipsilateral <6cm
  - N_{2c} - Bilateral / contralateral <6cm
- N_3
  - N_{3a} - Any node/s >6cm
  - N_{3b} - Extranodal extension ⊕

M

- M_0 - No distant metastasis
- M_1 - Distant metastasis

G

- G_x - can't be assessed
- G_1 - WD
- G_2 - MD
- G_3 - PD

STAGE GROUPING:

- 0 - Tis N0 M0
- I - T1 N0 M0
- II - T2 N0 M0
- III
  - T3 N0 M0
  - T1,2,3 N1 M0
- IVA
  - T4a N0,1 M0
  - T1,2,3,4a N2 M0
- IVB
  - Any T N3 M0
  - T4b Any N M0
- IVC - Any T Any N M1

For HPV mediated (p16+) Oropharyngeal cancer

T

- T_0 - no primary identified
- T_1 - size ≤ 2cm
- T_2 - 2-4 cm
- T_3 - >4 cm
- T_4 - moderately advanced local disease

N

- N_x - cannot be assessed
- N_0 - no regional LN mets
- N_1 - ≥1 ipsilateral nodes <6cm
- N_2 - Contralateral / Bilateral nodes <6cm
- N_3 - Lymphnode (s) >6cm

M

- M_0 - No distant metastasis
- M_1 - Distant metastasis

No grading system

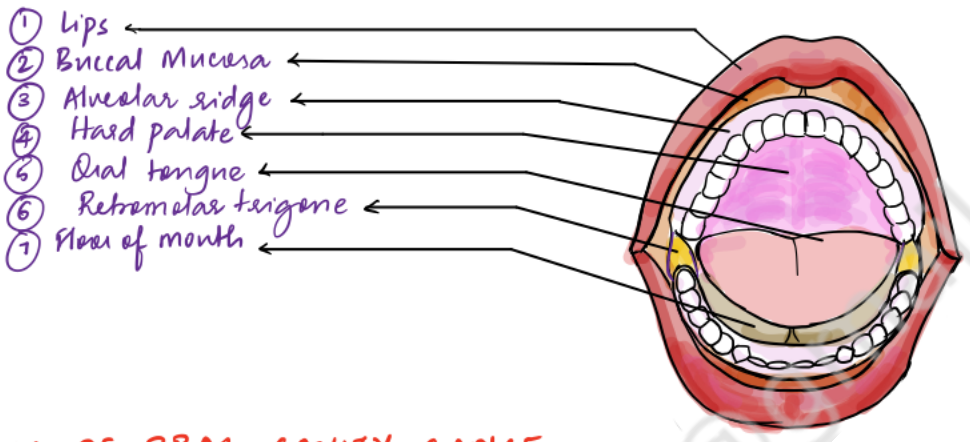
STAGE GROUPING

I	T0,1,2	N0,1	M0
II	T0,1,2	N2	M0
	T3	N0,1,2	M0
III	Any T	N3	M0
	T4	Any N	M0
IV	Any T	Any N	M1

ORAL MALIGNANCIES

ORAL CAVITY: Region extending from the vermillion border of the lips to the circumvallate papillae of the tongue and the junction between the hard palate and soft palate

ORAL CAVITY SUB-SITES



AJCC 8 STAGING OF ORAL CAVITY CANCER

T

Tx - cannot be assessed

Tis - in situ

T_1 — size ≤ 2cm; DOI ≤ 5mm (Depth of Invasion)

T_2 — ≤2cm & DOI >5mm; 2-4cm & DOI ≤ 10mm

T_3 — 2-4 cm & DOI >10mm; >4 cm & DOI < 10mm

T_4 — T_{4a}: >4cm & DOI >10mm; Invades adjacent structures

T_{4b} — invades masticator space/pterygoid plates, skull base / encases ICA

N

Nx - cannot be assessed

N_0 - no regional LN mets

N_1 - single, ipsilateral node ≤ 3cm

N_2 — N_{2a} - single, ipsilateral node 3-6cm; N_{2b} - multiple ipsilateral <6cm; N_{2c} - Bilateral / contralateral <6cm

N_3 — N_{3a} - Any node/s >6cm; N_{3b} - Extranodal extension (+)

M

M_0 - No distant metastasis

M_1 - Distant metastasis

G

Gx - can't be assessed

G_1 - WD

G_2 - MD

G_3 - PD

STAGE GROUPING:

0 - Tis N_0 M_0

I - T_1 N_0 M_0

II - T_2 N_0 M_0

III — T_3 N_0 M_0; $T_{1,2,3}$ N_1 M_0

IVA — T_{4a} $N_{0,1}$ M_0; $T_{1,2,3,4a}$ N_2 M_0

IVB — Any T N_3 M_0; T_{4b} Any N M_0

IVC - Any T Any N M_1

APPROACH TO ORAL MALIGNANCIES

1) History & Physical examination - Tobacco exposure

2) Biopsy

3) Imaging

PRIMARY

MRI > CT

- Tongue
  - to evaluate extent of bone marrow invasion
- Nasopharyngeal Ca – for skull base cranial nerves
  - Perineural spread

CT ± MRI

Cortical bone / Periosteal invasion
Laryngeal cartilage invasion

NODES

Extent of cross sectional imaging
↓
Skull base to thoracic inlet

(upto carina for thyroid)

OPG - for oral cavity cancers requiring mandibulotomy, mandibulectomy & in RT candidates

Distant mets - FDG/PET / CT thorax

PRECANCEROUS PATHOLOGIES OF ORAL CAVITY

[Ref: WHO handbook Pathology & Genetics of H&N tumors-2005]

PREMALIGNANT LESIONS (1978)
(EPITHELIAL PRECURSOR LESIONS -2005)

- Morphologically altered tissue in which oral cancer is more likely to occur, than its apparently normal counterpart

Histological characters of Epithelial precursor lesions (WHO-2005)
- Squamous cell hyperplasia
- Dysplasia - Mild / Moderate / Severe
- Carcinoma in situ

MORPHOLOGICAL TYPES - DESCRIPTIVE TERMS (no histological correlation)

① **LEUKOPLAKIA** - white patch / plaque that cannot be rubbed off / cannot be characterised clinically or pathologically as any other disease

TYPES

HOMOGENOUS
- uniform thin white area
- may or may not alternate ī normal mucosa

NON-HOMOGENOUS
- Speckled
- Nodular
- Verrucous

↓

PROLIFERATIVE VERRUCOUS LEUKOPLAKIA

↓

↑ risk of malignant transformation

Chronic hyperplastic candidiasis presents as speckled leukoplakia

② **ERYTHROPLAKIA** - red patch which cannot be otherwise characterised

51% → invasive SCC
40% → Ca in situ
9% → mild to moderate dysplasia

PREMALIGNANT CONDITIONS
[Precancerous condition - 2005]

- generalised state a/ī significantly ↑ Ca risk.
- signifies that cancer can arise in ANY PART OF THE ORAL CAVITY, and NOT NECESSARILY in a PRE-EXISTING LESION

1) Sideropenic dysphagia - iron deficiency ↓ epithelial atrophy → Ca
[Plummer-Vinson / Paterson-Kelly so]

2) Oral lichen planus
chronic mucocutaneous immune inflammatory condition

3) Oral submucous fibrosis - chronic, progressive oral condition a/ī chewing ARECANUT (usually as a component of Betel Quid)
Fibroelastic transformation of the juxtaepithelial connective tissue
↓
Mucosal rigidity
Fibrous bands
Mucosal pallor
Histologically - epithelial atrophy, Keratosis, dysplasia

4) Xeroderma pigmentosum - Ca tongue

5) Syphilitic glossitis - tertiary syphilis

6) Discoid lupus erythematosis - Ca lip

7) Epidermolysis bullosa dystrophica may be a/ī - Oral leukoplakia
SCC

CONDITIONS A/Ī MALIGNANT TRANSFORMATION (Ref B&L 27E)

HIGH RISK
- ERYTHROPLAKIA
- PROLIFERATIVE VERRUCOUS LEUKOPLAKIA
- CHRONIC HYPERPLASTIC CANDIDIASIS

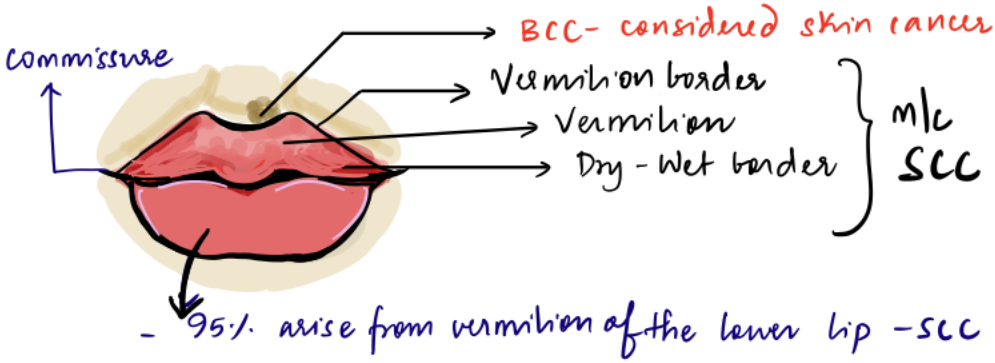
MEDIUM RISK
- ORAL SUBMUCOUS FIBROSIS
- SYPHILITIC GLOSSITIS

LOW RISK / EQUIVOCAL RISK
- ORAL LICHEN PLANUS
- DISCOID LUPUS ERYTHEMATOSUS
- DYSTROPHIC KERATOSIS CONGENITA

LIP CANCER

Precancerous condition - Actinic cheilitis

Epidemiology: - M:F :: 15:1
- Related to sun / UV radiation exposure



- 95% arise from vermilion of the lower lip - SCC

ANATOMY

stratified non-Keratinised squamous epithelium
Muscle - Orbicularis oris
Blood supply
- sup & inf labial arteries (branches of facial A)
Sensory - Upper lip - infraorbital (V_2)
Lower lip - mental (V_3)

Enlarging discrete lesion → ulcerates

Sometimes, background of LEUKOPLAKIA / CIS

SPREAD - Dermal lymphatic invasion → Erythema of adjacent skin
Deeper invasion → palpable induration
→ Skin, Orbicularis muscle

adjacent - commissures
Buccal mucosa
mandible
mental nerve

Perineural invasion - 2% cases

Lymphatic spread → Upper lip - preauricular, infraparotid
→ Ia, Ib → Internal jugular chain
→ ~5% at diagnosis - ∝ Grade, Size, Invasion, Recurrence

MANAGEMENT

① Leukoplakia, severe dysplasia, Carcinoma in situ - VERMILIONECTOMY / LIP SHAVE

② T_{is}, <1cm T_1 → SURGERY - can be done if resection is feasible & 1° closure without reduction of oral stoma

③ T_{1-4} (>1cm) Comissure involvement → RT - cosmetic & functional advantages over surgery (provided there is no bony involvement / substantial loss of normal tissue)

④ Bony involvement, Substantial tissue loss → Surgery & Reconstruction

MARGIN - 5mm

RT indications - +ve margins (if re-resection not feasible)
- Perineural / LVI
- Definitive RT - if tumor involves upper lip / commissures / >2cm

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LNs - Clinically node negative neck - observe / RT in high risk
N+ → MRND / RND
Delayed neck dissections

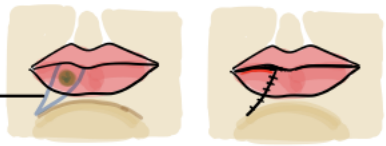
PRINCIPLES OF SURGERY FOR LIP CANCER

LATERAL LIP

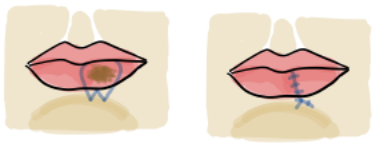
SMALL DEFECTS

Excision:

- WEDGE
  - angled to blend into chin crease



- 'W' EXCISION
  - for larger lesions



- STAIR/STEP ADVANCEMENT FLAP (Johansen flap)

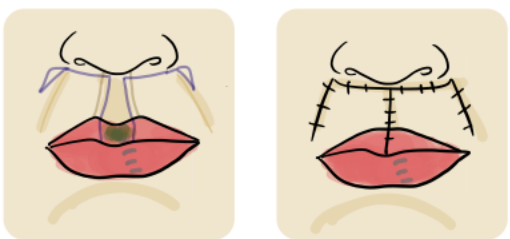
LARGER DEFECTS

- Commissure involved → ESTLANDER FLAP
- Based on superior or inferior labial A.s → Lip switch flaps
- Commissure spared → ABBE SARITTINI FLAP

CENTRAL LIP DEFECTS

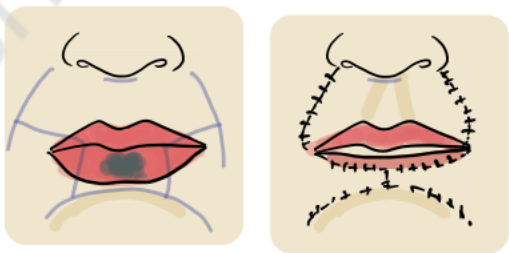
UPPER LIP

- WEBSTER FLAP

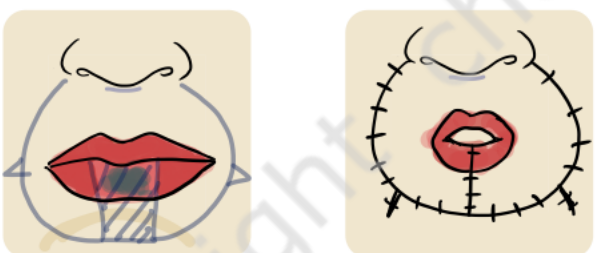


LOWER LIP

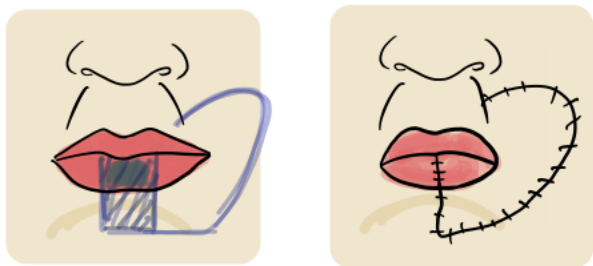
- BERNARD FLAP



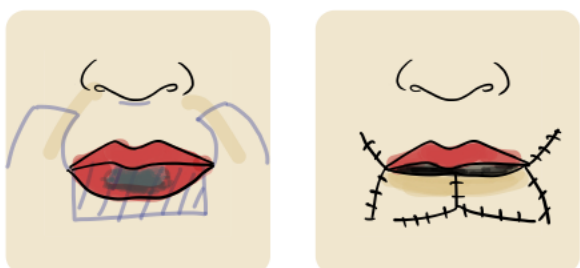
- KARAPANDZIC FLAP



- GILLIES FAN FLAP



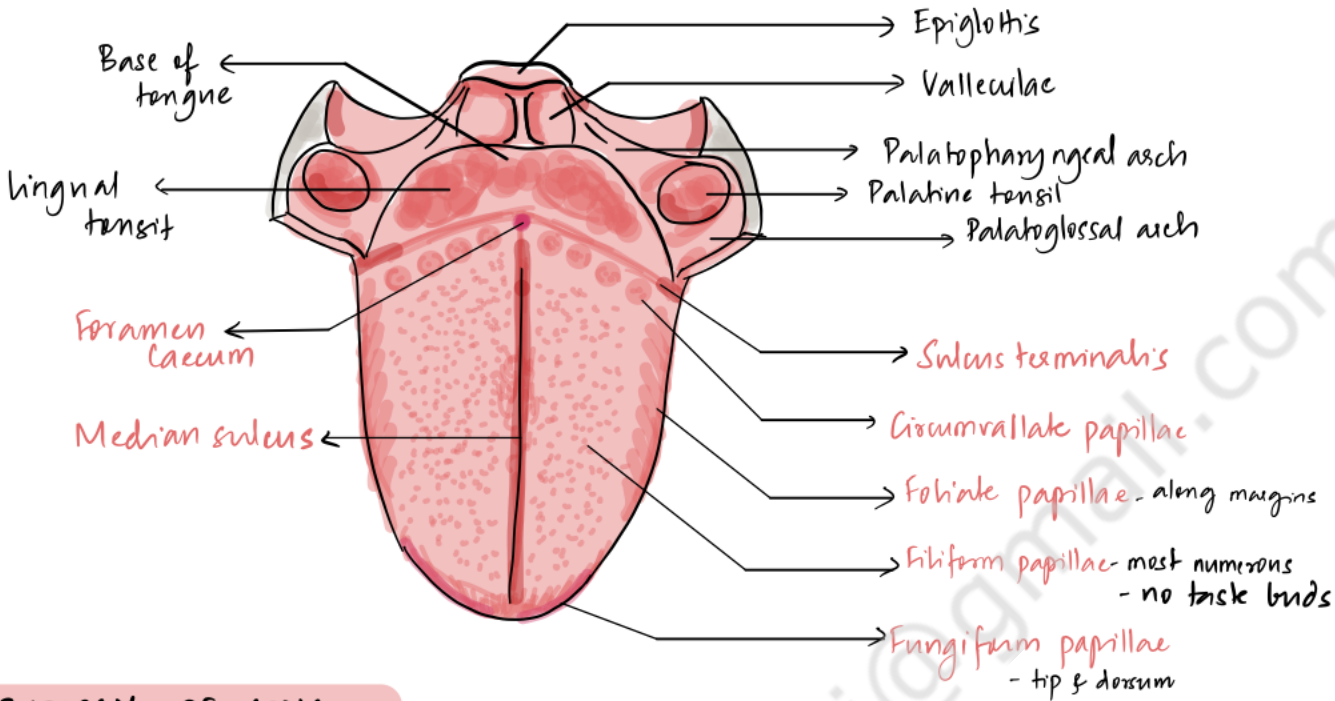
- GATE FLAPS



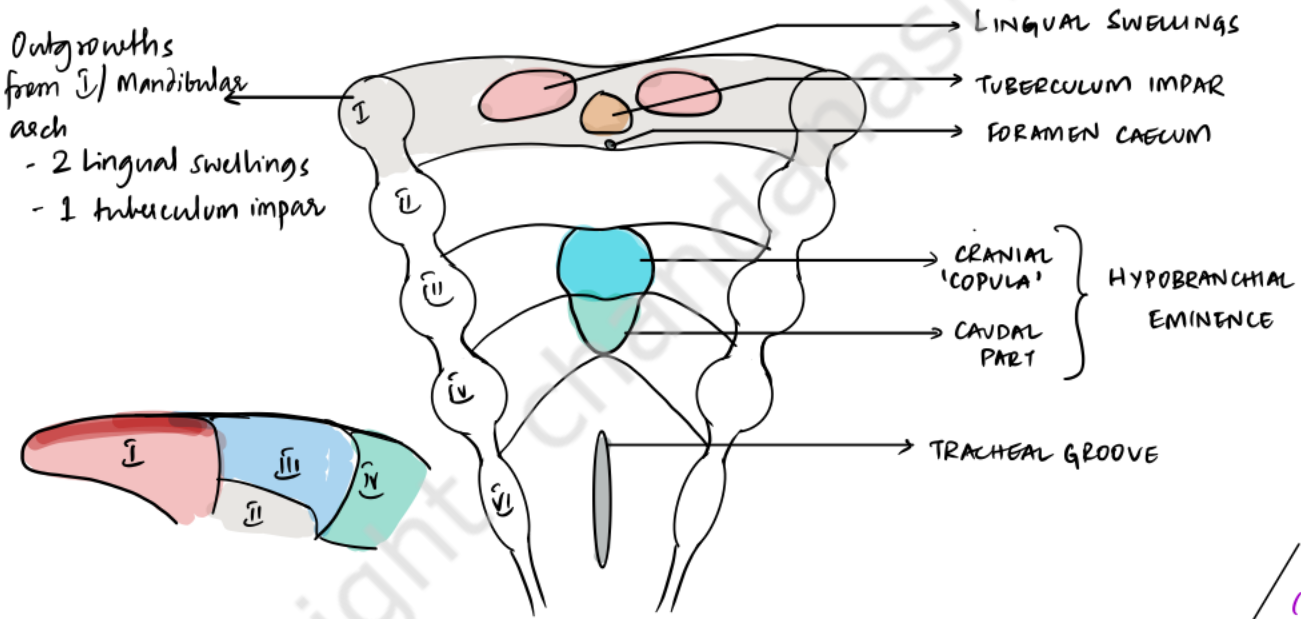
Bilateral nasolabial island flaps

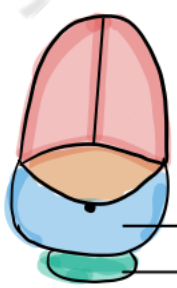
TONGUE

RELEVANT ANATOMY



EMBRYOLOGY OF TONGUE





Anterior 2/3rd of tongue - from I arch
Oral tongue - mobile
Pretremal N → Chorda tympani (Special sense - taste)
Post-tremal N - Mandibular N → Lingual N
General sensations

Posterium 1/3rd of tongue (from copula) - III arch - Glossopharyngeal N
(fixed) (BOT)

Epiglottis (from caudal part of Hypobranchial eminence) IV arch — Vagus (Superior laryngeal branch)

Muscles of the tongue are derived from OCCIPITAL MYOTOMES → Innervation - HYPOGLOSSAL NERVE

Arterial supply → Lingual arteries (br. of ECA)

MUSCLES OF THE TONGUE

INTRINSIC MUSCLES

Mainly alter the SHAPE of the tongue

1) SUPERIOR LONGITUDINAL - shortens tongue, curls apex & sides
2) INFERIOR LONGITUDINAL - shortens tongue, uncurls apex
3) TRANSVERSE - Narrows & elongates tongue
4) VERTICAL - Flattens & widens tongue

EXTRINSIC MUSCLES

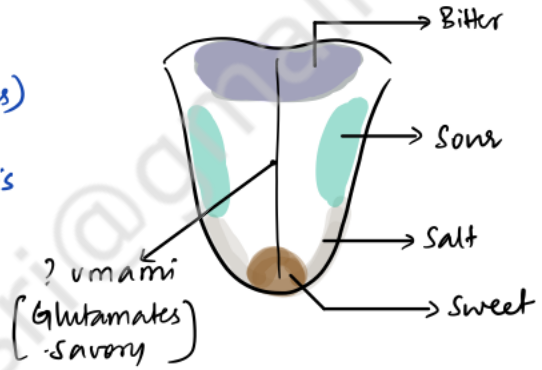
Mainly alter the POSITION of the tongue

1) GENIOGLOSSUS - Protrudes tongue
2) STYLOGLOSSUS - Elevates & retracts tongue
3) HYOGLOSSUS - Depresses & retracts tongue
4) PALATOGLOSSUS - Elevates posterior tongue

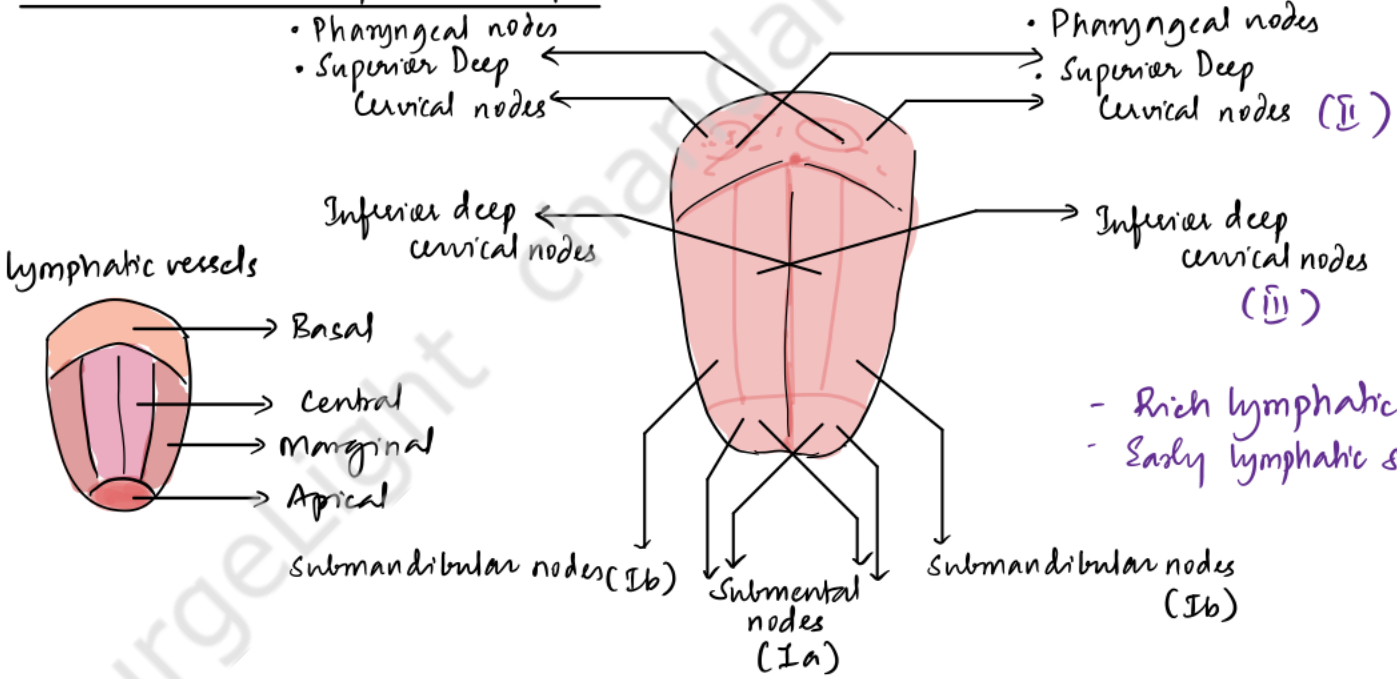
Innervation - all are innervated by HYPOGLOSSAL NERVE
EXCEPT PALATOGLOSSUS → innervated by pharyngeal branch of vagus

HYPOGLOSSAL NERVE INNERVATES :

1) Intrinsic Muscles of tongue
2) Extrinsic muscles of tongue (except palatoglossus)
3) GENIOHYOID
4) INFRAHYOID STRAP MUSCLES via Ansa cervicalis
   - Sternothyroid
   - Sternohyoid
   - Thyrohyoid
   - Omohyoid



LYMPHATIC DRAINAGE OF TONGUE



- Rich lymphatic network
- Early lymphatic spread

- Tip of the tongue drains into submental lymphnodes
- Lateral margins → subperiosteal lymphatics of mandible → Deep cervical nodes
  (Can involve bone)
- Mid-dorsum - free communication across midline → Bilateral neck nodes (R) esp in posterior 1/3rd
- Posterior 1/3rd - Deep cervical nodes, pharyngeal nodes

CARCINOMA TONGUE

Epidemiology & etiology - similar to other oral malignancies

SITES

m/c - Lateral margin - 50 %.
Posterior 1/3rd - 20 %.
Ventral surface - 10 %.
Tip - 10 %.
Dorsum - 10 %.

TYPE

SCC - m/c malignancy

Rarely - Leiomyosarcomas
Rhabdosarcomas

CLINICAL FEATURES

- EXOPHYTIC / ULCERATIVE / SUBMUCOSAL MASS - a/c tenderness / irritation
- Induration beyond the visible margin
- Excessive salivation - often blood tinged - foul odor

T_{4a} - invasion of cortical bone, extrinsic muscles, facial skin

T_{4b} - invasion of masticator space, pterygoid space, skull base

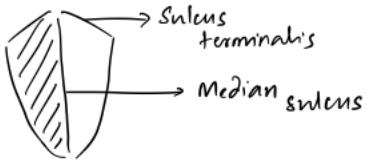
- Ankyloglossia - muscle involvement / floor of mouth involvement
- Trismus
- Referred otalgia

Depth of invasion 4-5mm, LN met ~30%.

MANAGEMENT

Early lesions - T_1, T_2 - partial glossectomy ± 1° closure / skin graft - transorally (→ for smaller lesions)
↓
Margin (>5mm → negative; 1-2 cm recommended)

Larger lesions (>2cm) - hemiglossectomy ± flap reconstruction (free flap) (RFF)



T_2, T_3 - Moderately advanced lesions - add post op RT / CRT

T_4 - Near total / total glossectomy / Definitive Radiation ± Mandibulectomy

Neck dissection → Clinically node negative → ND recommended if DOI >4mm
→ + Floor of mouth invasion if DOI >2mm

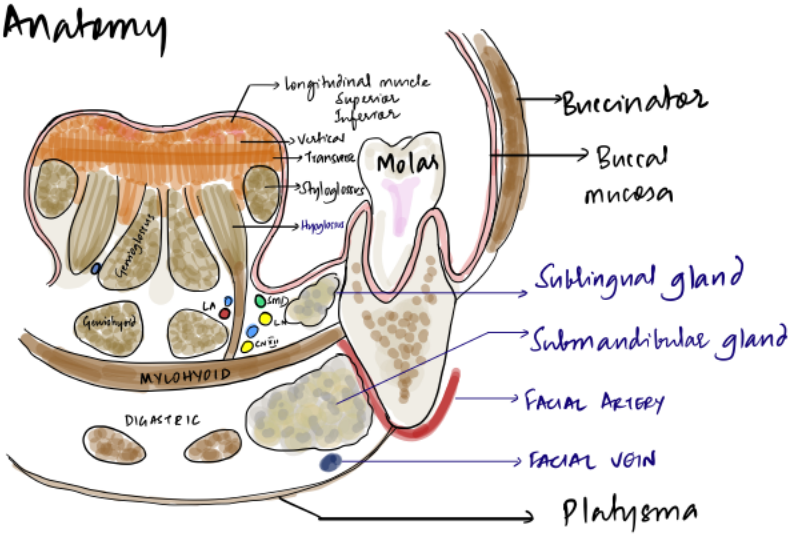
APPROACHES

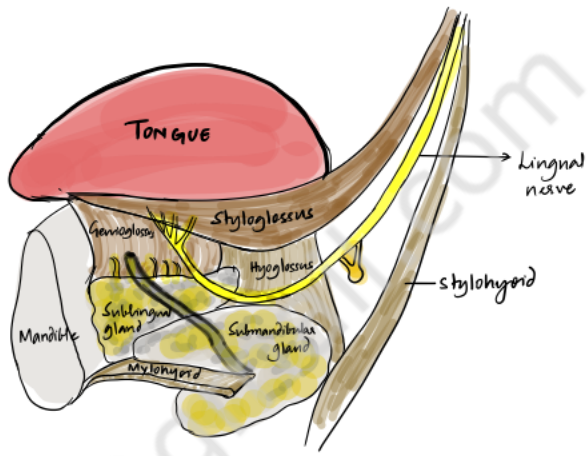
1) Transoral
2) Cheek flap
3) Mandibulotomy / Lip split approach
4) Mandibular lingual releasing approach / Visor flap approach

FLOOR OF MOUTH

'U' shaped area bounded by lower gingiva & oral tongue terminating posteriorly at the anterior tonsillar pillar

Anatomy





CA FLOOR OF MOUTH

- Most neoplasms are SCC - moderate grade ; 5% - mucoepidermoid & adenoid cystic carcinomas
- 90% originate within 2cm of anterior midline of FOM
- Spread - beneath mucosa into sublingual gland → genioglossus & geniohyoid
  - Extends along the periosteum, rather than through it (Mandibular invasion - late)
  - Mylohyoid - barrier → goes behind the muscle & emerges in submandibular space of neck.
  - Posteriorly invades muscles of root of tongue
  - Submandibular duct obstruction
- 30% have clinically + nodes on presentation (I B, II m/c)
- 4% - B/L nodes
- T_1-T_2 lesions - occult neck nodes 10-15%

MANAGEMENT

EARLY LESIONS

Surgery / RT - equally effective for T_1, T_2 lesions

Surgery > RT ; ∵ RT complications

WLE (small ≤ 5mm lesions) transoral, ≥ 1cm margin

T_1 lesions - Brachytherapy

Intraoral cone RT 65 Gy

MODERATELY ADVANCED LESIONS

Rim resection / Marginal mandibulectomy

Segmental mandibulectomy + Osteomyocutaneous flap

Post op RT / CRT

Midline lesions - No neck - B/L functional ND

Larger lesions - EBRT 45-50Gy x 5W

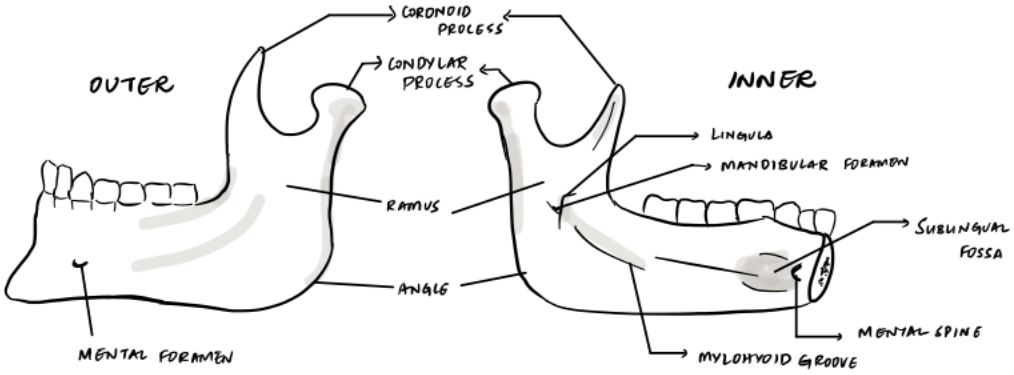
Interstitial RT 20-30Gy

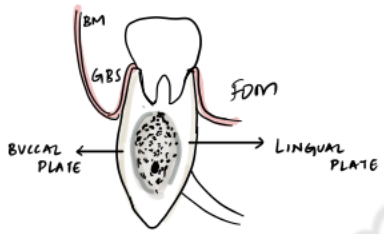
ADVANCED LESIONS

Primary CRT / RT

MANDIBULAR RESECTIONS

ANATOMY





Lingual plate is weaker than Buccal plate

1. MARGINAL MANDIBULECTOMY

Indications

- Floor of mouth / Buccal mucosal lesions within 1cm from mandible
- Minimal / NO bony erosion

Contraindications

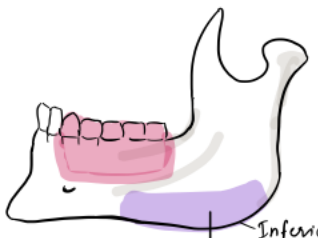
- Irradiated mandible
- Edentulous mandible
- Gross erosion & #
- Cancer involving both surfaces of the mandible
- Inability to preserve the inferior alveolar artery

Bony bridge should be atleast 1 cm tall to prevent stress fracture of remnant

Marginal mandibulectomy for RMT Ca:

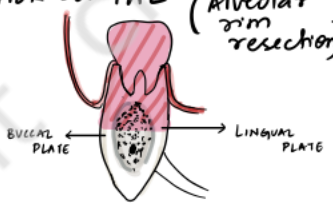
anterior aspect of asc. ramus excised ± coronoid process

TYPES OF MARGINAL MANDIBULECTOMY

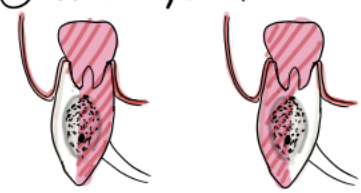


① REVERSE MARGINAL MANDIBULECTOMY (done for advanced neck disease infiltrating mandible)

② HORIZONTAL - Classical (Alveolar rim resection)



③ VERTICAL / SAGITTAL



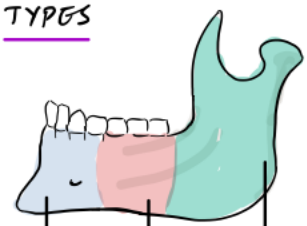
④ OBLIQUE

2. SEGMENTAL MANDIBULECTOMY

Indications :

- Gross bony invasion / erosion (Advanced T)
- Inadequate bony remnant i Marginal mandibulectomy (<1cm height) - PIPESTEM MANDIBLE
- Post RT / Recurrence

TYPES



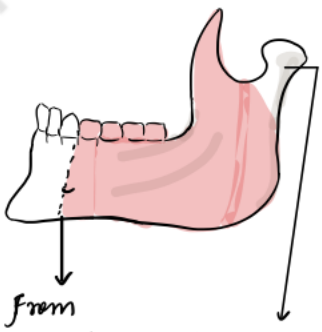
ANTERIOR SEGMENTAL (arch removed)

LATERAL SEGMENTAL (arch sparing)

POSTERIOR SEGMENTAL

Removal of ascending ramus, coronoid process & condyle

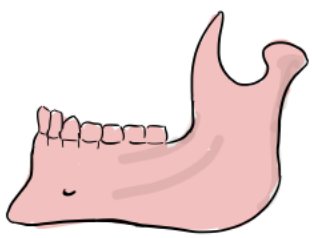
3. PARTIAL MANDIBULECTOMY



From Mental foramen

Condyle spared (to preserve TMJ)

4. HEMIMANDIBULECTOMY



Entire hemimandible is resected

MANDIBULOTOMY

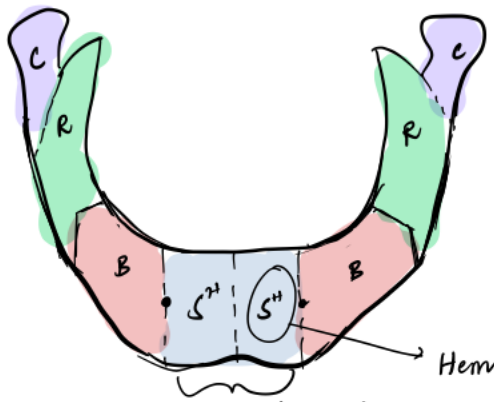
- NOT a RESECTION
- done to gain access to the lesion

MANDIBULAR RECONSTRUCTION

TYPES OF MANDIBULAR DEFECTS

(L) → any lateral segment without condyle

(H) → L + condyle



↳ 'Central' - C of HCL

ANDY GUMP DEFORMITY

Mandibular arch defect that creates the appearance of an absent chin and severely retrognathic jaw

↓

Central segment defects (segmental mandibulectomy crossing the midline and including the mandibular arch) require reconstruction with Osseocutaneous free flaps (RIGID support) to prevent the deformity

Andy Gump from the Comic Strip 'THE GUMPS'

Reconstructive Strategies

1) Primary closure
2) Soft tissue only - Eg PMMC
3) Alloplastic material - 2.4mm RECON PLATE
4) Combination - PMMC + Recon plate
5) Non vascularised bone grafts - Titanium tray + cancellous bone chips (iliac crest)
6) Vascularised bone grafts - Fibula - edentulous / dentate
   Iliac crest - dentate
   Scapula

CANCER OF THE HARD PALATE

- Rare - seen in males i practice of REVERSE SMOKING d/t repeated thermal injury
- Types - SCC
  Minor Salivary Gland tumors

Presents i painless / painful ulcer, bleeding, ill fitting dentures

SPREAD

- Palatal periosteum is a strong barrier to spread
- Spread into maxilla → nasal symptoms, facial swelling
- Anterolateral spread → alveolar ridge involvement - dental pain, loose teeth
- Perineural spread → along palatine branches of maxillary nerve (esp. adenoid cystic ca)
  - Greater palatine foramen
  - ↓
  - Pterygopalatine fossa
  - ↓
  - Cavernous sinus
  - ← Multiple cranial neuropathies
    - Facial numbness
    - Diplopia

MANAGEMENT

1) Surgery → TOC
   - WLE → healing by 2° intention / SSG for small lesions
   - Partial palatectomy i bone removal
   - Maxillectomy i reconstruction using maxillary obturator
     - Infrastructural maxillectomy
     - Lateral rhinotomy incision i WEBER FERGUSON EXTENSION

   - Limited Maxillectomy → resection of one wall of maxillary sinus
     - Palatectomy / Alveolectomy
     - Medial maxillectomy
   - Partial Maxillectomy → ≥2 walls resection (not including posterior wall)
   - Total Maxillectomy i Orbital preservation or reconstruction
     - (Hemimaxillectomy)

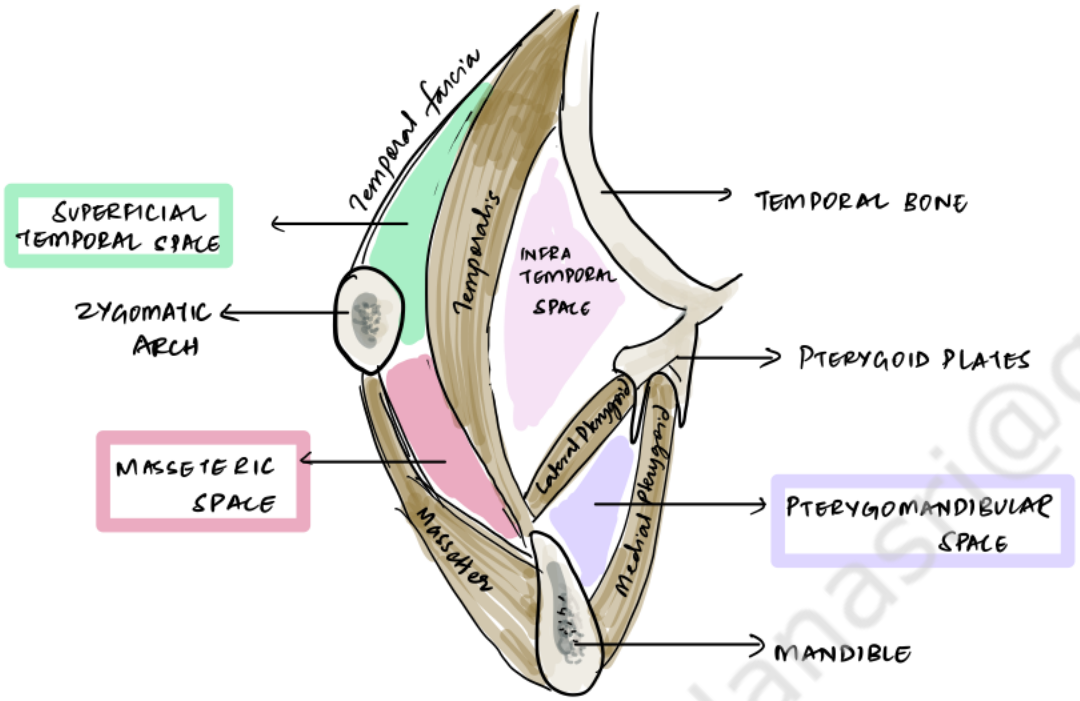
No need for elective ND

2) RT
   - Adjuvant RT
   - Primary RT for extensive unresectable perineural disease

CARCINOMA BUCCAL MUCOSA

Buccal mucosa - mucous membrane covering the inner surface of cheeks & lips
- ends above & below i a transition to gingiva
- ends posteriorly at RMT

RELEVANT SURGICAL ANATOMY



BUCCAL SPACE : Medial boundary- Buccinator
Lateral boundary- Zygomaticus major

Contents - Buccal pad of fat (Communicating posteriorly i retroantral fat pad) → Infratemp fossa
- Stensen's duct
- Facial & Buccal arteries, facial vein
- Branches of mandibular & facial nerve

SPREAD

- Early lesions - discrete, exophytic
Buccinator muscle - natural barrier to spread → advanced → infiltrate muscles ↓skin
- adjacent spread → Gingivobuccal sulcus → gingiva - bone
→ obstruction of stensen's duct → parotid enlargement
- involvement of lingual & dental nerves
  - pain
  - referred otalgia
- Posterior extension - behind pterygomandibular raphe → trismus
- LYMPHATIC → I, II
LN + at presentation 9-30%
Occult disease - 16%

m/c → SCC (in pre-existing leucoplakia, usually)
rarely minor salivary gland tumors
melanoma

MANAGEMENT

Surgery - WLE (≥ 1cm mucosal, soft tissue & bone margins)

APPROACHES - Per-oral, Cheek flap, Midline lip split, Angle split

- Superficial lesions of buccal mucosa not fixed to muscle - R_x - resection including the buccinator muscle as deep margin
- Extensive lesions involving buccinator muscle → full thickness cheek resection & wide margins

Reconstruction - graft / flap

- NECK DISSECTION
  - Nodal metastases - clinical / imaging
  - T_3 / T_4 cancers
  - T_1 / T_2 cancer if
    - Poor differentiation
    - tumor thickness >4mm (if tumor has palpable thickness)
- MANDIBULAR RESECTION
  in close abutment / involvement
  - Composite resection

RETROMOLAR TRIGONE

RMT- AJCC definition
attached mucosa overlying the ascending ramus of the mandible from the level of the posterior surface of the last molar tooth to the apex superiorly adjacent to the tuberosity of maxilla

The retromolar gingiva is in continuity with mucosa of
- Buccal region
- Floor of the mouth
- Mandibular alveolar ridge
- hard palate (maxilla)
- anterior tonsillar pillar
- soft palate

Mucosa
Keratinised mucosa

Beneath the mucosa of RMT → Pterygomandibular raphe [Pterygoid hamulus ↓ Mylohyoid ridge of mandible]
attachment of: • Buccinator
• Orbicularis oris
• Superior constrictor

Since the mandible is covered only by mucosa & periosteum at the RMT, tumors are often advanced at presentation ē bony destruction

SPREAD

1) Adjacent- Buccal mucosa, tonsillar pillar, maxilla
2) Posterior- Pterygomandibular space, medial pterygoid muscle
- TRISMUS
3) Posterolateral - Buccinator, Buccal pad of fat
4) Lymphatic spread - level I & II
LN ⊕ at presentation ~30%
Occult LN - ~15-25%.
5) Inferior alveolar nerve involvement
- Loss of sensation over chin
- Referred otalgia - burning

MANAGEMENT

① Surgery is the preferred treatment for all lesions - Minimum procedure
- MARGINAL MANDIBULECTOMY
→ Trans oral ē Lip split / Visor flap / cheek flap
Recon ē SSG / regional or free flap (fasciocutaneous / myocutaneous / osseocutaneous)

Neck → T_2-T_4 clinically N_0 patients < Elective Mx ē SOHND / RT
N+ → MRND / RND

② Radiation - Primary RT - for early lesions - BUT- risk of trismus, bone exposure, recurrence
Adjuvant RT for bony invasion, nodal mets

ALVEOLAR RIDGE

Upper alveolar ridge - similar to hard palate cancers

LOWER ALVEOLAR RIDGE (LAR)

- Malignancies - SCC ~ 90%.
  Verrucous carcinoma
  Adenocarcinoma
- Risk factors - Betel Quid ± Gut tobacco

MANDIBULAR INVOLVEMENT IN ORAL CANCERS

① It was earlier thought that lymphatics of tongue & floor of mouth pass through mandibular periosteum on their way to the cervical nodes
↓
Now disproved

② Tumor abutment and subsequent invasion

Ca Buccal Mucosa
Ca FOM
↓
Invade via buccal & lingual surface

Ca RMT
Ca LAR
↓
Invade via occlusal surface

③ Infiltration via cortical defects along SHARPEY's fibres (collagenous fibres bridging mucosa to the cortical bone)

④ Via foramena - mental foramen, mandibular foramen

Management

Surgery - Mandibular resection
Post-operative RT / CRT

PRINCIPLES OF NECK MANAGEMENT IN ORAL CANCERS

1) Tumor sites that have B/L LN drainage (BOT, palate, supraglottic larynx, hypopharynx)
2) Advanced lesions of anterior tongue, FOM, alveolus close to or crossing midline

→ B/L explorations / Contralateral SND

INDICATIONS FOR ELECTIVE NECK DISSECTION (END)

- Depends on risk of occult metastasis
  - Depends on Depth of invasion
    - >4mm → Strongly consider END esp if RT not planned
    - 2-4mm → clinical correlation
    - <2mm → only in highly select situations

Rough guidelines

N_0 → Selective neck dissection
- Oral cavities → I, II, III
- Oropharynx - II, III, IV

N_1, N_2 – Selective / Comprehensive

N_3 – Comprehensive

Malignancies of:

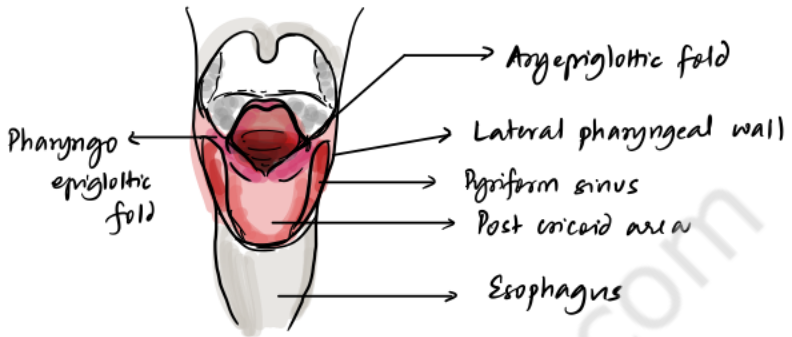
- Oropharynx
- Nasopharynx
- Larynx
- Maxillary antrum

HYPOPHARYNGEAL CANCER

Hypopharynx extends from level of hyoid bone to the lower border of the cricoid cartilage

SUBSITES

1) Pyriform sinus
   → m/c site of malignancy
2) Post cricoid region
3) Lateral & posterior pharyngeal walls



- 95% → SCC
- Rarely – Minor salivary gland tumors

CIS is seen at the edge of pharyngeal wall SCCs
→ multifocal → clear margins difficult to obtain by excision

PYRIFORM SINUS

Early lesions- nodular mucosal irregularities

Medial lesions
- spread along aryepiglottic fold & arytenoids
  ↓
  invade false vocal cords

- extend posteriorly to post-cricoid
  → cricoid cartilage
  opp. pyriform sinus

Extensive submucosal spread ⊕
Central ulceration ⊕

Vocal cord fixity d/t
- infiltration of intrinsic muscles of larynx
- infiltration of cricoarytenoid joint
- infiltration of RLN

POST CRICOID

Early postcricoid lesions are rare

Lesions arising from posterior wall tend to remain on posterior wall

Lesions arising from anterior wall invade posterior cricoarytenoid muscle & cricoid & arytenoid cartilages

- Advanced tumors encircle the lumen

PHARYNGEAL WALL

Posterior pharyngeal wall
- tend to remain in the posterior wall (↓ circumf. spread)
- grow up (palate & nasopharynx) and down the wall
- infiltrate posteriorly

Lateral pharyngeal wall
- Early lesions are well defined, exophytic

Penetrate laterally through constrictor muscle
↓
Enter lateral pharyngeal space
↓
Soft tissues of the neck

Clinical features

- Unilateral sore throat
- Dysphagia
- Ear pain
- Voice change
- Pooling of secretions (Blood streaked)
- Cervical lymphadenopathy

↓

BOCA sign - loss of laryngeal crepitus on side to side movement of larynx

STAGING AJCC-8

T - T_x - cannot be assessed
T_{is} - in situ

T_1 - limited to one subsite of hypopharynx
≤ 2cm

T_2 - involving > 1 subsite
or 2-4 cm

T_3 - > 4cm
or fixation of hemilarynx / extension to esophagus

T_4
- T_{4a} - invades thyroid/ cricoid cartilage, hyoid, thyroid gland
central compartment soft tissue
- T_{4b} - invades prevertebral fascia
Carotid artery
Mediastinal structures

Management

T_1, T_2 → RT > { • TORS/ TLM
• Partial laryngectomy & neck dissection

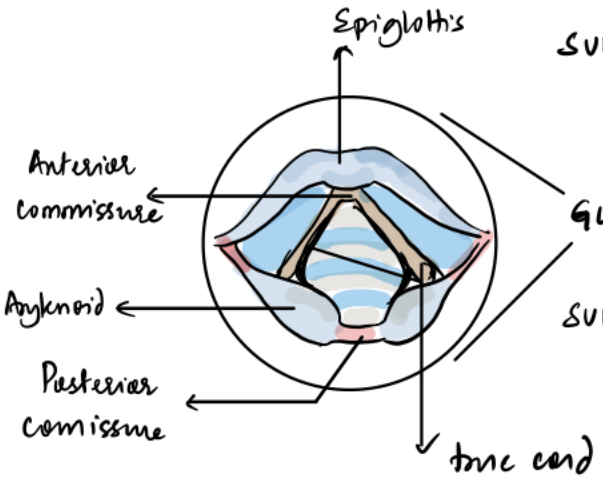
Advanced — Resectable, fit, willing → Total laryngopharyngectomy & RND + Recon ± gastric pull up + Post op RT

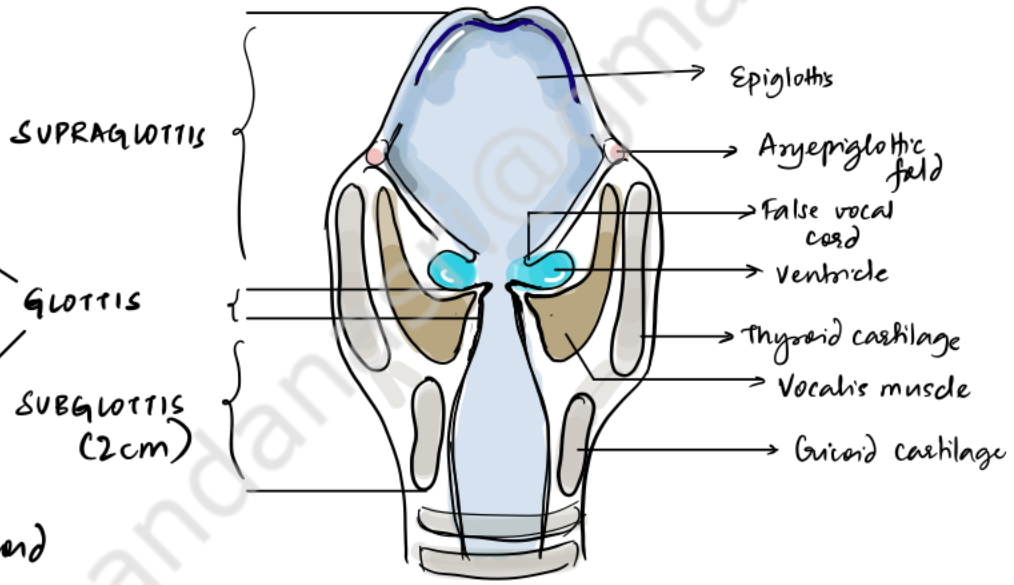
Unresectable, unfit → RT

LARYNGEAL CANCER

SUBSITES

- **SUPRAGLOTTIC**
  - Epiglottis
  - False vocal cords
  - Ventricles (lat & superior surface)
  - Aryepiglottic folds
  - Arytenoids
- **GLOTTIC**
  - True vocal cords
  - Anterior commissure
  - Posterior commissure
- **SUBGLOTTIC**
  - region below vocal cords upto inferior border of cricoid cartilage





95% SCC

Others - adenocarcinoma
sarcoma
neuroendocrine

Smoking >>> Alcohol

CIS vs invasive SCC - risk of missing areas of microinvasion & vocal cord biopsies

→ both are treated ō either endoscopic transoral laser resection / RT

SUPRAGLOTTIC CANCER

- Exophytic growth
- Infiltrate destroy epiglottis
- Invade - vallecula
  pre-epiglottic space
  lateral phar. walls
- False vocal cords - submucosal cancer
- AE folds → invade pyriform fossa
- GLOTTIC & SUBGLOTTIC extension - late phenomena

- Moderately rich capillary lymphatic plexus
  ↓
  pass through pre-epiglottic space & thyrohyoid membrane to Level II
  > Level III, IV

↑ LN ⊕ at Dx

Often no symptoms
- Sore throat
- intolerance to hot / cold food
- Ear pain

GLOTTIC CANCER

- Majority of lesions on FREE MARGIN & UPPER SURFACE of VOCAL CORD
- >2/3rd - unilateral
- Anterior 2/3rd of cord - m/c

- Invades - ventricles | subglottis
  - False cord
  - arytenoids

vocal ligament, thyroarytenoid
↓
thyroid cartilage
↓
PARAGLOTTIC SPACE, neck

- Essentially NO CAPILLARY LYMPHATICS IN GLOTTIC REGION

Neck nodes ⊕ seen after
- Supraglottic spread (II, III, IV)
- Subglottic spread (III, IV, VI)

↓ LN ⊕ in early stages

- PERSISTENT HOARSENESS

- Usually presents relatively early

SUBGLOTTIC CANCER

- Rare

- involves cricoid cartilage EARLY

- Cord fixation is common

- Relatively few capillary lymphatics
  ↓
  pass via cricothyroid membrane to
  - Central gp (VI)
  - Level IV

~10% LN ⊕ at Dx

- Usually no symptoms until locally extensive

'T' STAGING 'AJCC 8' - T_x - cannot be assessed, T_{is} - carcinoma in situ

T_1 - limited to 1 subsite of supraglottis

T_2 - invades mucosa of >1 adjacent subsite (Supraglottis / Glottis / Extraglottic) [BOT/Vallecula, pyriform fossa] without laryngeal fixation

T_3 - limited to larynx ± Fixed VC ± invasion of - Postcricoid area preepiglottic space, paraepiglottic space, inner cortex of thyroid cartilage

T_{4a} - outer cortex of thyroid cartilage Trachea, Esophagus, tongue muscles neck soft tissues, thyroid →

T_{4b} - Prevertebral musc, Carotid A Mediastinum →

T_1 - limited to VC
T_{1a} - 1 VC T_{1b} - Both VC (Normal VC mobility)

T_2 - extends to supraglottis and/or subglottis and/or impaired vocal cord mobility

T_3 - limited to larynx ± Fixed VC ± invasion of paraglottic space, inner cortex of thyroid cartilage

T_1 - limited to subglottis

T_2 - extends to VC ± normal / impaired VC mobility

T_3 - limited to larynx ± Fixed VC ± invasion of paraglottic space, inner cortex of thyroid cartilage

SUPRAGLOTTIC CANCER

T_{1-2} - RT | Supraglottic laryngectomy

T_3 - RT | ± Salvage Surgery
or Surgery + Post op RT

T_4 - Surgery + Post op RT

GLOTTIC CANCER

Tis - cord stripping | RT

T_{1-2} - RT > Surgery - Cordectomy
Hemilaryngectomy

T_3 - limited tumors - RT ± Salvage Sx
extensive - Sx → RT / CRT

T_4 - total laryngectomy → RT/CRT
or CCRT for larynx preservation

SUBGLOTTIC CANCER

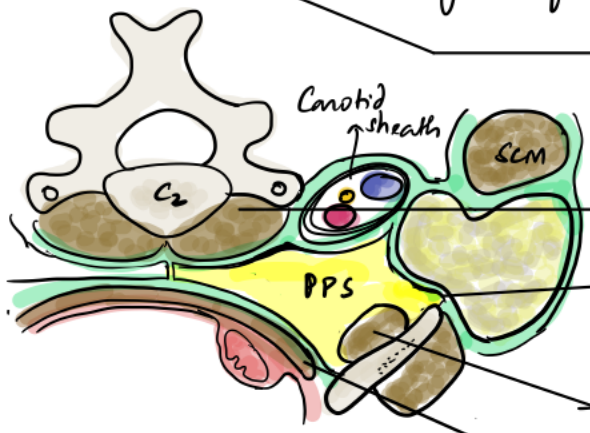
Usually extensive when discovered

RT ± Surgery

Local tumor control <25%.

TUMORS OF THE PARAPHARYNGEAL SPACE

Paraphayngeal space: Anatomically complex potential space between investing layers of deep cervical fascia



→ INVERTED PYRAMID - starts at skull base and extends down to the greater cornu of the hyoid bone

→ Posteriorly - PREVERTEBRAL MUSCLES

→ Laterally - Deep lobe of PAROTID RAMUS OF THE MANDIBLE

→ Anteriorly - PTERYGOID MUSCLES

→ Medially - CONSTRICTOR MUSCLES

Important structures in PPS - CAROTID SHEATH
Cranial nerves XI, XII
Cervical sympathetic chain

M/c tumor of PPS - Deep lobe parotid tumors extending into PPS
↓
Pleomorphic adenoma

Other tumors of PPS: Paraganglionomas
Schwannomas
Neurofibromas
Sarcomas
Meningiomas
Lymphomas

~80% of PPS tumors are benign

Clinical presentation:
- Neck mass causing blunting of angle of mandible inferior displacement of submandibular gland
- Fullness of soft palate
- Bulge in lateral pharyngeal wall
- Medial displacement of palatine tonsil → tonsillar asymmetry
- Cranial neuropathies
- Trismus

Approach for Mx - transcervical / transparotid
Skull base - anterior mandibulotomy

NASOPHARYNGEAL CANCER

Nasopharynx - extends from base of skull to soft palate
- lies behind nasal cavity
- communicates anteriorly ⇕ nasal cavity (via posterior choanae)
  inferiorly ⇕ oropharynx
  laterally ⇕ middle ear via Eustachian tube

Fossa of Rosenmuller - situated in the lateral wall of nasopharynx behind Torus tubarius
→ m/c site for nasopharyngeal Ca

Epidemiology - ↑ in Chinese
EBV association
M > F 3:1
Younger age - ~20% < 30y

HPE
- 85% Carcinoma
  - WHO I - Keratinizing SCC
  - II - non Keratinizing SCC → EBV
  - III - undiff / basaloid SCC → Lymphoepithelioma
- 10% Lymphoma
- 5% Others
  - Melanoma
  - Plasmacytoma
  - Juvenile angiofibroma
  - Sarcoma
  - Paraganglionoma
  - Minor Salivary gland tumors

Clinical features

1) High posterior cervical lymphadenopathy - 80%
   - maybe bilateral (50%)
2) Epistaxis
3) Nasal obstruction
4) Voice change
5) Unilateral hearing loss / fullness in one ear - serous otitis
6) Trismus
7) Headache

8) Cranial nerve involvement

RETROSPHENOIDAL SYNDROME

CN - II - VI

(often indicates cavernous sinus invasion)

- Unilateral ophthalmoplegia } III, IV, VI
- Ptosis
- Trigeminal neuralgia
- Unilateral weakness of muscles of mastication } V

RETROPAROTID SYNDROME

Cranial Nerves: IX to XII
- Sympathetic plexus

- Dysphagia
- Dysgeusia
- Tongue weakness
- Horner's Syndrome

Investigations

- Endoscopy
- CT / MRI

Management

RT

Surgery - usually not feasible

NECK DISSECTION

TYPES

COMPREHENSIVE NECK DISSECTIONS

Removal of all lymphatic tissue in the lateral neck, (levels I to V) along with extralymphatic structures (SAN, SCM, IJV)

Carried out in N+ disease

1) RADICAL NECK DISSECTION

Level I to V lymphnodes, SAN, IJV, SCM, Submandibular gland } removed

Structures spared
- Carotid artery
- Brachial Plexus
- Nerves: Vagus, Hypoglossal N, Lingual N

Indications

N+ neck for SCC with
- SAN involvement
- extensive soft tissue disease
- invasion of SCM, IJV

('N_3' disease)

2) MODIFIED NECK DISSECTION

Level I to V lymphnodes, submandibular gland } removed

1) MRND - I - SAN spared
→ m/c ND for N+ SCC of upper aerodigestive tract

2) MRND - II SAN, SCM spared

3) MRND - III SAN, SCM, IJV spared
→ Functional neck dissection
↓
Done for N+ DTC

SELECTIVE NECK DISSECTIONS

Selective removal of nodal regions at risk (based on predicted spread pattern) + sparing of all non-lymphatic tissue (SAN, SCM, IJV)

- Carried out in clinically N_0 neck (c ≥15-20% risk of occult nodes)
- CONTROVERSIAL - for nodal mets CONFINED TO FIRST ECHELON NODES (usually N_1)
  - requires post op RT in such cases

1) SUPRAOMOHYOID NECK DISSECTION (SOHND)

Levels removed - I, II, III

Submandibular gland REMOVED

[• For oral & oropharyngeal N_0 SCC
• For N_0 melanoma anterior to ear]

2) EXTENDED SOHND

Levels removed - I, II, III, IV

Submandibular gland - REMOVED

[• For N_0 SCC of lateral tongue]

3) LATERAL NECK DISSECTION

Levels - II, III, IV

(• For N_0 SCC of larynx, hypopharynx)

if 1° crosses midline, LND is done B/L

4) MODIFIED LATERAL NECK DISSECTION

Levels - II, III, IV, V

[• For thyroid cancers c lateral neck nodes - 'Therapeutic' - for N_1 in addition to CND]

5) POSTEROLATERAL NECK DISSECTION

Levels - II, III, IV, V
+ Suboccipital & Retroauricular

[N_0 melanoma posterior to ear]

6) CENTRAL NECK DISSECTION

Levels - VI, VII

[- Therapeutic dissection for disease limited to central compartment nodes for thyroid cancer]

Recommendations - for clinically N0 neck

- When primary tumor is to be removed surgically, an END (despite N0) should be performed when risk of regional LN mets is ≥ 15%

Definition of risk groups - from DeVita

TABLE 45.4
Definition of Risk Groups for the Clinically N0 Neck

Group	Estimated Risk of Subclinical Neck Disease	T Stage	Site
I: Low risk	<20%	T1	Floor of mouth, oral tongue, retromolar trigone, gingiva, hard palate, buccal mucosa
II: Intermediate risk	20%–30%	T1	Soft palate, pharyngeal wall, supraglottic larynx, tonsil
		T2	Floor of mouth, oral tongue, retromolar trigone, gingiva, hard palate, buccal mucosa
III: High risk	>30%	T1–T4	Nasopharynx, pyriform sinus, base of tongue
		T2–T4	Soft palate, pharyngeal wall, supraglottic larynx, tonsil
		T3–T4	Floor of mouth, oral tongue, retromolar trigone, gingiva, hard palate, buccal mucosa

Reprinted with permission from Mendenhall WM, Million RR. Elective neck irradiation for squamous cell carcinoma of the head and neck: analysis of time-dose factors and causes of failure. *Int J Radiat Oncol Biol Phys* 1986;12(5):741–746.

N_+ neck

MRND of ipsilateral N_+ disease without ECE + RT / CCRT postop } if Sx is planned for 1°

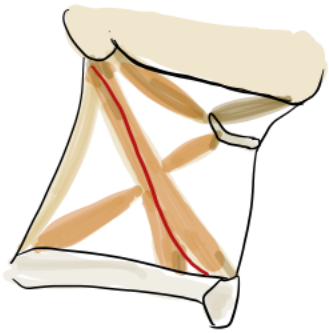
If primary lesion is to be managed by RT/CCRT

check response after 4 wks on CT scan

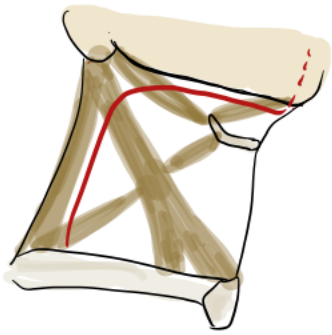
- Complete Regression → RT alone is sufficient
- +ve nodes ≥1.5 cm → PET-CT 12 weeks later → +ve → Salvage neck dissection

Planned neck dissection in N_2, N_3 disease IRRESPECTIVE OF RESPONSE

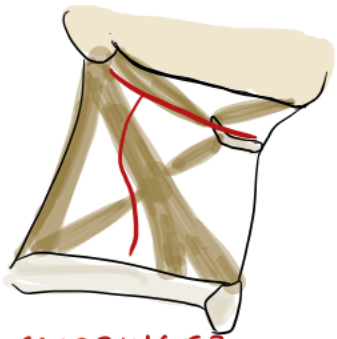
Incisions for Comprehensive neck dissections



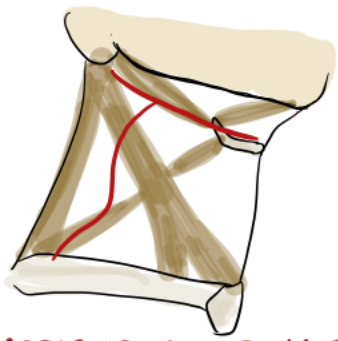
HOCKEY STICK



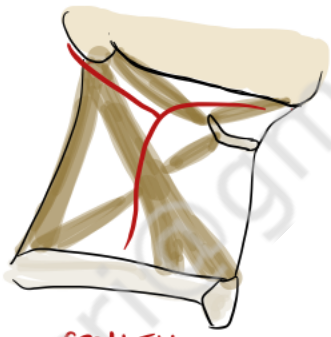
BOOMERANG



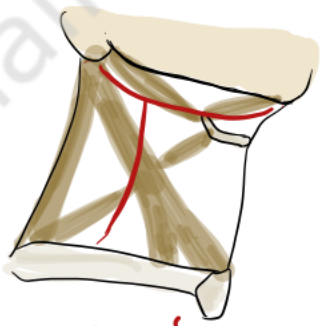
SCHOBINGER



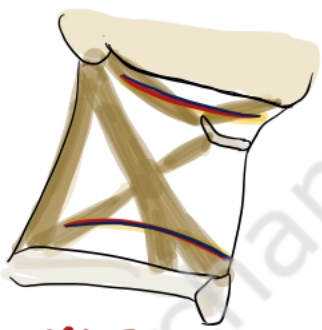
MODIFIED SCHOBINGER



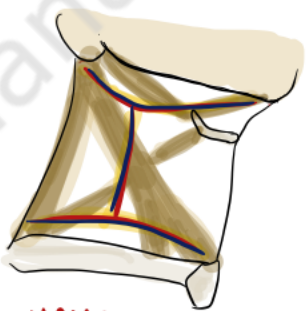
CONLEY



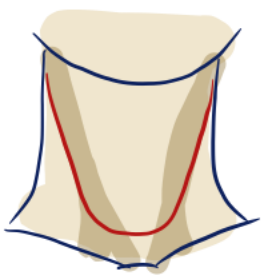
CRILE'S



MACFEE



HAYES MARTIN



DOUBLE HOCKEY STICK / APRON

Considerations

1) Skin flap viability - broad based flaps, plane - subplatysmal, avoid bifurcate incisions (avoid acute angles) incisions as far as possible
2) Consider risk of carotid exposure while adding 2° incisions
3) Factor in - exposure
   - reconstruction strategy
   - likelihood of re-operation

COMPLICATIONS OF NECK DISSECTION

Table 12.1 Contributors to neck and shoulder disability based on level of neck dissection

Anatomical level	Structure affected	Impairment/disability
Level Ia	Fibrofatty tissue	Mild cosmetic deformity
Level Ib	Hypoglossal N Lingual N Marginal mandibular N	Ipsilateral tongue hemiplegia, dysphagia, dysarthria Ipsilateral tongue paresthesia, dysphagia, dysgeusia, dysarthria Paralysis of lower lip depressor, cosmetic deformity, lower lip trauma
Level IIa	Spinal accessory N Hypoglossal N Great auricular N	Shoulder and neck ROM and strength Ipsilateral tongue hemiplegia, dysphagia, dysarthria Ipsilateral pinna paresthesia
Level IIb	Spinal accessory N	Shoulder and neck ROM and strength
Level III	Phrenic N Ansa cervicalis N	Hemi diaphragm paralysis/DOE, pneumonia Hyolaryngeal elevation
Level IV	Phrenic N Thoracic duct	Hemidiaphragm paralysis/DOE, pneumonia Chyle leak
Levels II–IV	Jugular vein Vagus N Cervical rootlets Sympathetic trunk Carotid artery	Lymphedema Ipsilateral vocal cord paralysis, dysphonia, aspiration Cervical paresthesia Horner's syndrome[a] TIA, stroke
Level V	Spinal accessory N[b] Brachial plexus Cervical rootlets	Shoulder and neck ROM and strength Hand and arm paresthesias and weakness, hand or arm paralysis, severe pain Cervical paresthesia

Abbreviations: DOE, dyspnea on exertion; N, nerve; ROM, range of motion; TIA, transient ischemic attack.
[a]Horner's syndrome: triad of ptosis, meiosis, and anhydrosis resulting from injury to the cervical sympathetic trunk.
[b]Increased shoulder impairment with dissection of this level.

Complications

1) Wound infection, dehiscence
   - avoid cross contamination i upper aerodigestive tract
   - antibiotic prophylaxis
   - incision planning
   - gentle tissue handling
   - meticulous closure
   - eliminate dead spaces

2) Hemorrhage → expanding hematoma → venolymphatic obstruction → SUPRAGLOTTIC EDEMA
   - routinely examine superior thyroid A
     occipital A
     transverse cervical A
     facial A

3) IJV & Carotid Blowout

4) Stroke

5) Nerve injuries

- SAN
- Marginal mandibular nerve
- Vagus
- Phrenic nerve
- Hypoglossal nerve
- Lingual nerve
- Brachial plexus & cervical rootlets
- Sympathetic chain

6) Chyle leak - Thoracic duct injury during (L) level IV dissection

↳ Intra-op dx - clip/tie/ligate

Post-op chyle leak - Drain monitoring
Bed rest
avoid straining
stool softeners
MCFA diet
Octreotide

Persistent chyle leak - >500ml/d - explore surgically & ligate
tissue adhesives
- embolisation
+ TPN

7) Venous air embolus

8) Pneumothorax - while dissecting near lung apices

9) Hypoparathyroidism / Hypocalcemia - in central neck dissections

10) B/L IJV injury / ligation - Cerebral edema, Blindness
Facial congestion

CAROTID BODY TUMOR

CAROTID BODY - originates from
- neuroectodermal-derived neural crest lineage of the third branchial arch
- Mesoderm → stroma

→ located in the adventitia/periadventitial tissue at the CCA bifurcation along the POSTERIOR SURFACE
→ innervated by glossopharyngeal nerve (exclusively sensory)
→ Blood supply - predominantly ECA
- also, vertebral artery

→ Largest mass of chemoreceptive tissue anywhere in the body

↑ pCO_2
↑ Blood temperature
↓ pH
↓ PaO_2
⊕ → Chemoreceptor cells → ↑ minute volume ventilation, ↑ Pulse rate, ↑ Mean BP

CAROTID BODY TUMORS - belong to the paraganglioma family

PARAGANGLIOMAS - family of neoplastic tumors that can occur anywhere along the autonomic ganglia

∴ Neural crest ectoderm differentiates into chemoreceptor cells that migrate in close association with the autonomic ganglion cells.

PARAGANGLIOMAS

SYMPATHETIC		PARASYMPATHETIC	
Paravertebral thoracic sympathetic chain	Posterior mediastinal paraganglioma	Paraganglia in middle ear along Jacobson's N/ Arnold's N	Glomus tympanicum
Retroperitoneal sympathetic nerve fibres	Retroperitoneal paraganglioma	Paraganglia in adventitia of jugular bulb	Glomus jugulare
Organ of Zuckerkandl	Paraganglioma of Organ of Zuckerkandl	Vagus - m/c nodose ganglion within carotid sheath	Glomus vagale
		Carotid body at CCA bifurcation	Carotid Body tumor
Sympathetic nerve fibres in pelvic organs	Urinary bladder paraganglioma	Aortico-pulmonary paraganglia	Anterior mediastinal paraganglioma

CAROTID BODY TUMORS

- Rare tumors
- Sporadic > Hereditary
  → 10-35% - autosomal dominant
- Tumors as Hyperplasia
  ↓
  a/c hypoxia - COPD, congenital heart disease, high altitude (prolonged hypoxemia)
- 5th - 7th decade

Highly vascular tumors

Synthesize neuropeptides & enzymes → detected by IHC

5-7% → malignant → risk max in young pt & family history

SPREAD - locally invasive

- adventitia of adjacent carotid vessels - along posterior aspect of bifurcation
- widen the angle between ECA & ICA - 'splaying' - 'Lyre' sign
- encase the main trunk & proximal tributaries of ECA (rarely involve ICA) - ? because ECA is the vascular supply to Carotid body.
- May spread to local lymphnodes → malignant

Clinical features

- asymptomatic neck mass - near angle of mandible
- fixed mass (no longitudinal movement; mild side to side) - firm, smooth, lobulated
- transmitted carotid pulsations
- 30-40% → audible bruit
- Cranial nerve involvement - Hypoglossal N > Vagus > Laryngeal N > Symp. chain
  ↓
  Horner's Syndrome
- Large tumors - extend to base of skull
  - bulge in lateral wall of oropharynx & deviation of soft palate
- TIA - rare (usually ⊕ if there is associated carotid plaque)

INVESTIGATIONS

- Carotid DUPLEX - non invasive,
- Selective Carotid angiography — Gold standard; but INVASIVE
  - can show presence of other concomitant cervical paragangliomas
  - pre-op embolization if necessary
  - demonstration of carotid bifurcation
  - overall size, extent & VASCULARITY of tumor
  - major arterial supply of tumor
  - presence of aberrant ascending cervical/vertebral artery branch
  - demonstration of plaques in carotid
- MR/CT - recon gives very good picture
  - non invasive

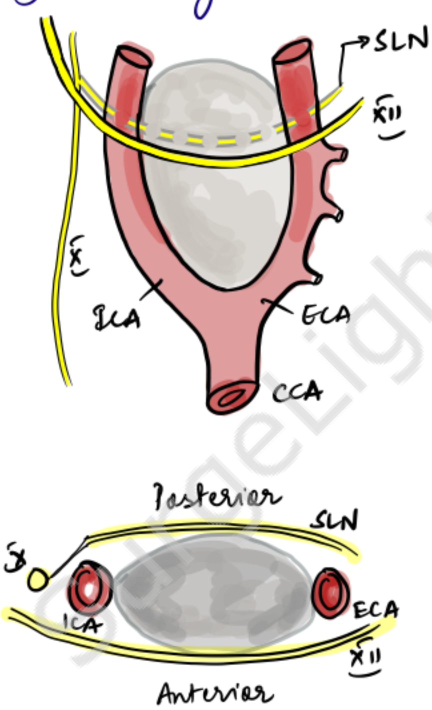
CLASSIFICATION

SHAMBLIN CLASSIFICATION

GROUP I

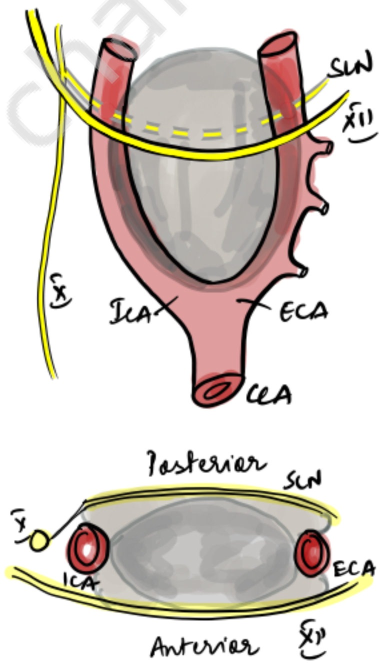
Tumors that can be freely dissected from the wall of the Carotid artery

generally < 5cm



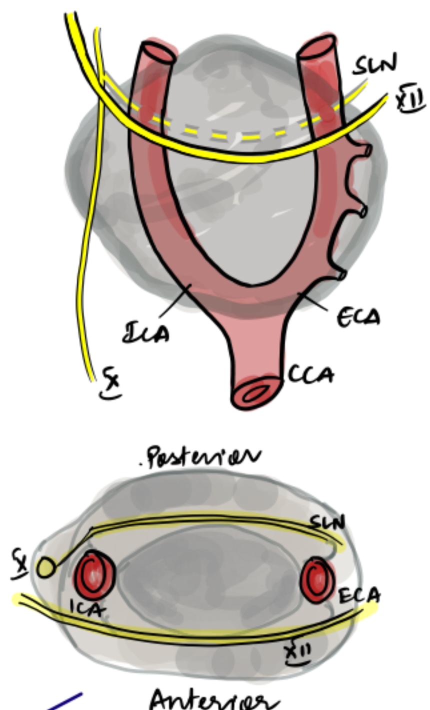
GROUP II

Tumors the partially surround the circumference of the carotid artery



GROUP III

Tumors intimately adherent to the entire circumference of carotid bifurcation



Group II & Group III → Generally require pre-operative embolization

MANAGEMENT

- Surgical excision ± pre-operative embolisation of feeding vessels

  Complications - Bleeding
  Cerebrovascular complications
  Cranial nerve deficits

- Radiation therapy

  Adjunct

  Pre-op radio
  - Bulky
  - Inoperable

  Primary RT

  - Recurrent tumors
  - Poor surgical candidates

RECURRENT LARYNGEAL NERVE

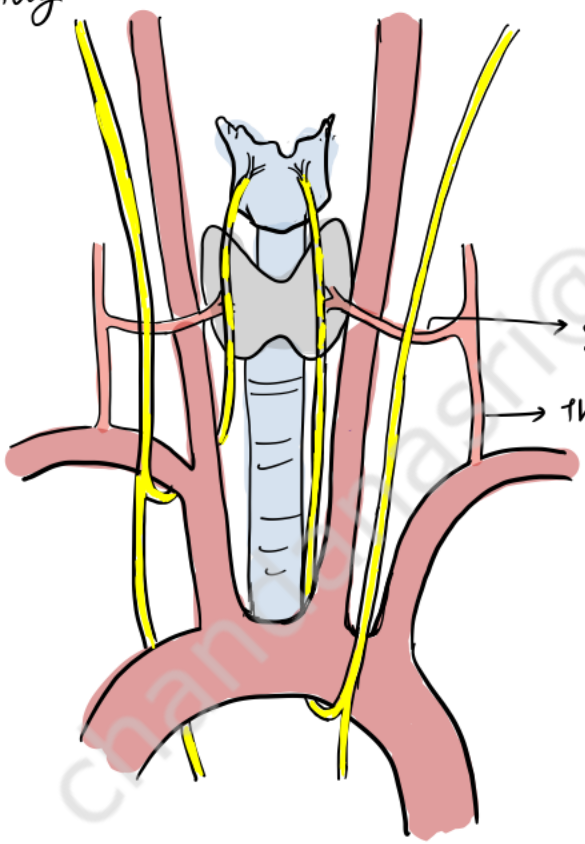
Anatomy - Recurrent = retrace their path cranially after branching out from vagus

RIGHT

- Arises from the vagus as it courses anterior to the subclavian artery
- Passes inferior and posterior to (R) subclavian artery
- Ascends lateral to trachea in the tracheo esophageal groove

LEFT

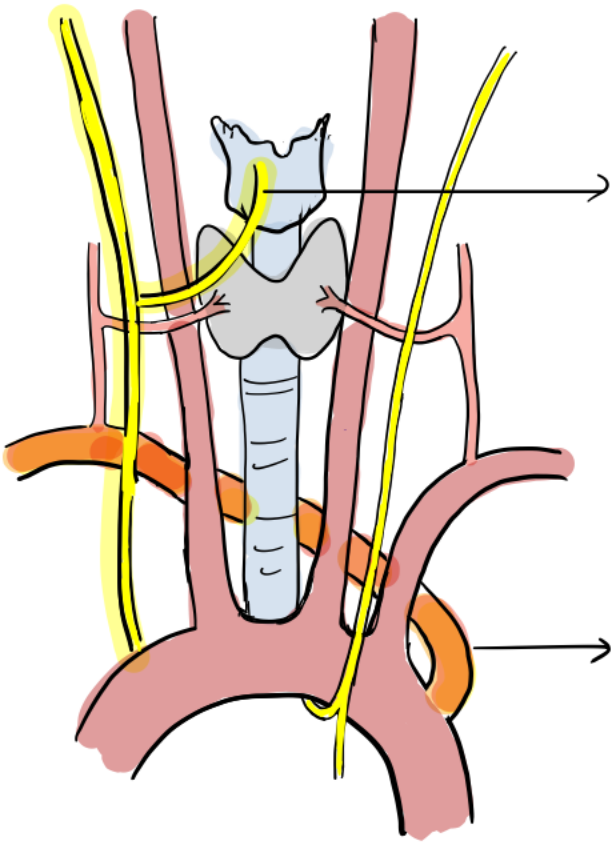
- Arises from the vagus as it passes anterior to the arch of the aorta
- Passes inferior & postero-medial to the arch at the ligamentum arteriosum
- Ascends & enters tracheo-esophageal groove



- Along their course in the neck, the RLNs may branch, pass anterior/posterior to ITA or interdigitate with the branches of ITA

- Has mixed - motor, sensory & autonomic functions
  - motor → intrinsic muscles of larynx ↓ except cricothyroid
  - sensory → Infraglottic larynx
  - autonomic → Parasympathetic

RLN - anomalies - more common on the right

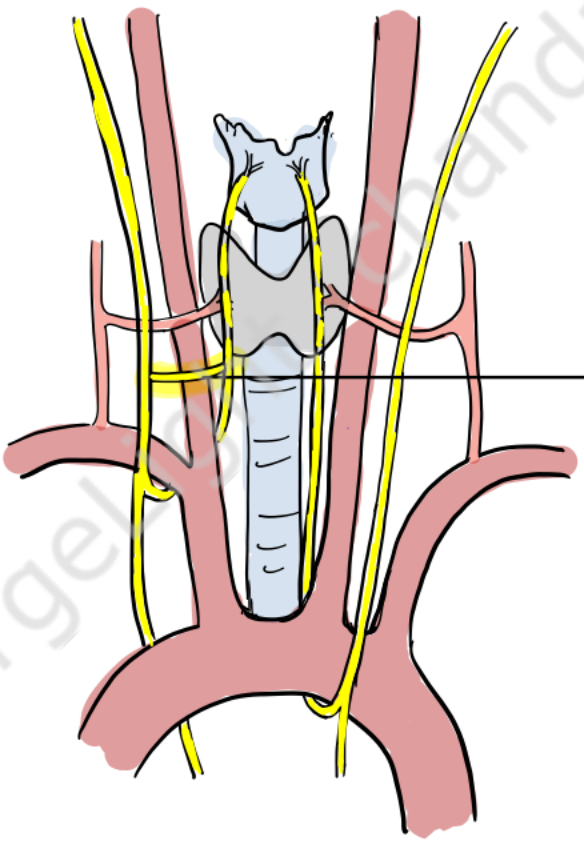


Non recurrent Ⓡ laryngeal nerve
(0.5 - 1.5 %)

'Dysphagia Lusoria'
Arteria lusoria

Aberrant origin of Ⓡ Subclavian A

4th arch anomaly



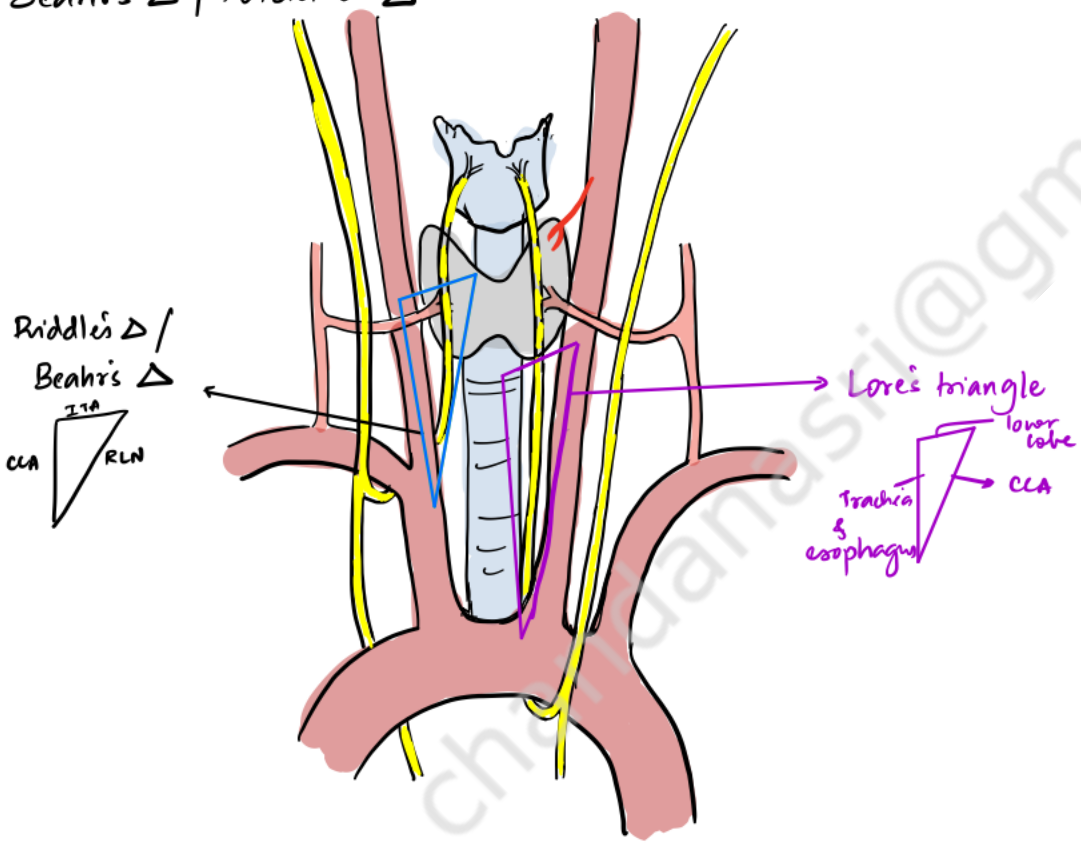
Co-existent non recurrent Ⓡ laryngeal N

Non recurrent Ⓛ RLN → a/i situs inversus
Ⓡ sided aortic arch

Recurrent Laryngeal nerve injury

- RLN is most vulnerable to injury during the last 2-3cm of its course
- Intra-operative landmarks for RLN

Beahrs Δ / Riddles Δ



Intra-operative nerve monitoring may also be used

INJURY

U/L → Asymptomatic

Mild voice change

↓

Voice improves as contralateral cord compensates

B/L → Cords tend to lie in median / paramedian position

↓

DYSPNEA, STRIDOR

SUPERIOR LARYNGEAL NERVES

Branch out from the vagus at the skull base
↓
Travel along internal carotid artery
↓
Branch at the level of the hyoid bone

Internal Laryngeal N
↓
Pierces thyrohyoid membrane
↓
Sensory to supraglottic larynx

External Laryngeal N
↓
Motor to the cricothyroid muscle (tensor of vocal cords)

- Injury leads to issues in voice projection esp. in high hitting notes
- fatigue during prolonged speech

CERNEA classification
Type 1 - crosses STA ≥1cm above lobe
Type 2a - <1cm above lobe
Type 2b - below lobe

Joll's triangle - level of thyroid cartilage
for external laryngeal N

INJURY

U/L → weak voice

B/L → very weak voice

Combined palsy (RLN + ELN)
- U/L
  - Cadaveric position
  - Hoarseness
  - aspiration
- B/L
  - Aphonia
  - Aspiration
  - Inability to cough
  - Pneumonia

LARYNGEAL MUSCLES < Intrinsic / Extrinsic

All intrinsic laryngeal muscles (except cricothyroid) are innervated by RLN

↓

External laryngeal Nerve

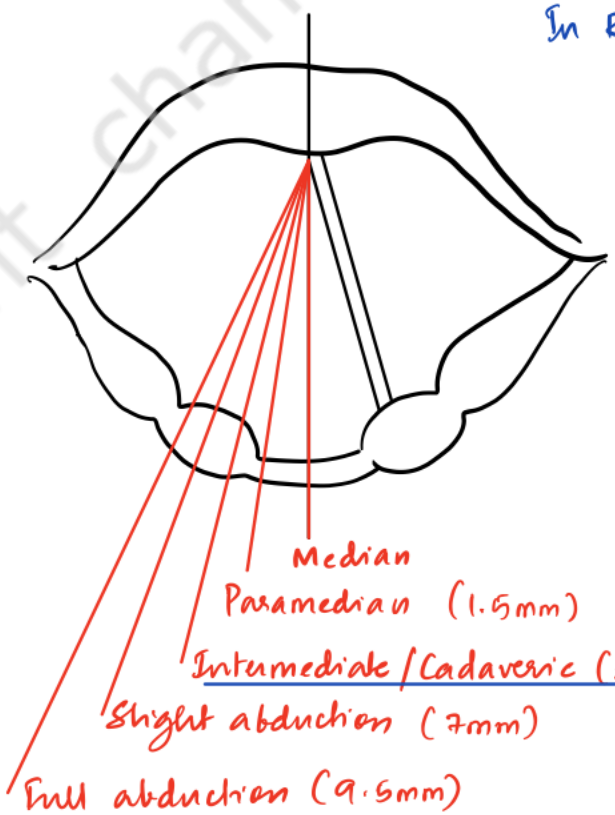
Acting on vocal cords

- **Adductors**
  - Lateral cricoarytenoid
  - Transverse arytenoid
  - Thyroarytenoid
- **Tensor**
  - Cricothyroid
- **Abductor**
  - Posterior cricoarytenoid

Acting on Laryngeal inlet

- **Opener of laryngeal inlet**
  - Thyroarytenoid
    - Thyroepiglottic part
- **Closers of laryngeal inlet**
  - Oblique arytenoid
  - Aryepiglottic

POSITIONS OF VOCAL CORDS



In RLN injury, cords tend to assume median/ paramedian position because

- **Semon's law** - in organic lesions abductor fibres (phylogenetically older) tend to get affected earlier
- **Wagner Grossman hypothesis**
  - Intact ELN → intact cricothyroid → adducts cords

} RLN palsy

→ Paralysis of ELN + RLN

↓

Neutral position of cricoarytenoid joint

TREATMENT OF LARYNGEAL PALSY

1) B/L RLN palsy → Tracheostomy
→ Lateralisation of cord
↙
1) Arytenoidectomy & fixation of VC laterally
open / endoscopic
2) Thyroplasty
3) Cordectomy
4) Muscle transfer
↓
Sternohyoid → posterior cricoarytenoid (abductor)

2) B/L ELN palsy
- To improve voice - thyroplasty IV
→ tighten

Combined palsy

U/L → Speech therapy
Medialisation of cord
- Injection of teflon paste
- Thyroplasty I - medial displacement of cord
- Muscle / Cartilage implant
- Asthrodesis of crico aryfenoid joint

B/L Combined palsy

Tracheostomy

Epiglottopexy

Vocal cord plication

Diversion procedures

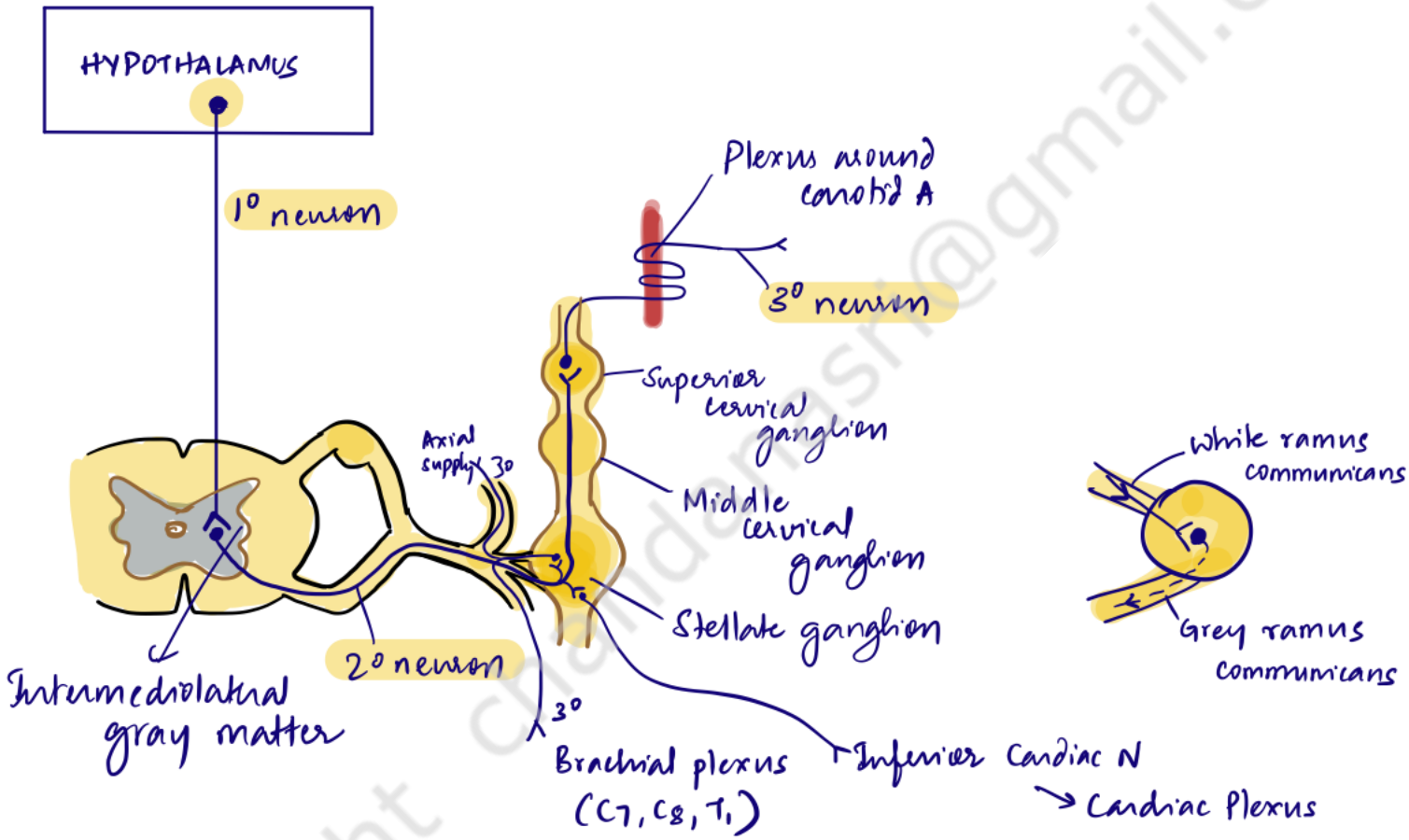
STELLATE GANGLION

forms from the fusion of INFERIOR CERVICAL GANGLION & FIRST THORACIC SYMPATHETIC GANGLION
⊕ in ~80% population

- Located anterior to the neck of FIRST RIB - sometimes anterior to C_7 transverse process

Posteriorly - longus colli
Laterally - carotid A

NEUROANATOMY



APPLICATIONS

- Horner's Syndrome
- Pancoast tumor
- Stellate ganglion block / or - Cervical sympathectomy for:
  - Upper limb ischemia
  - Raynaud's disease
  - Chronic regional pain
  - Tinnitis / Meniere's disease

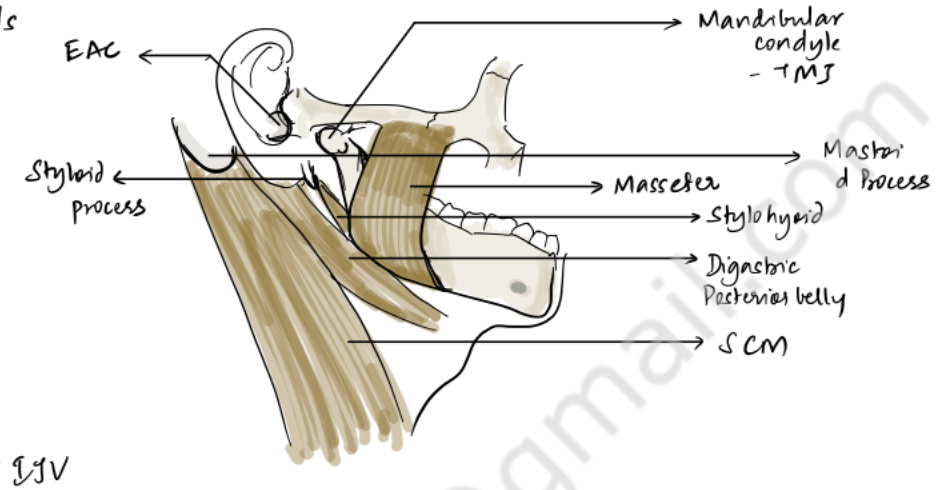
SALIVARY GLANDS

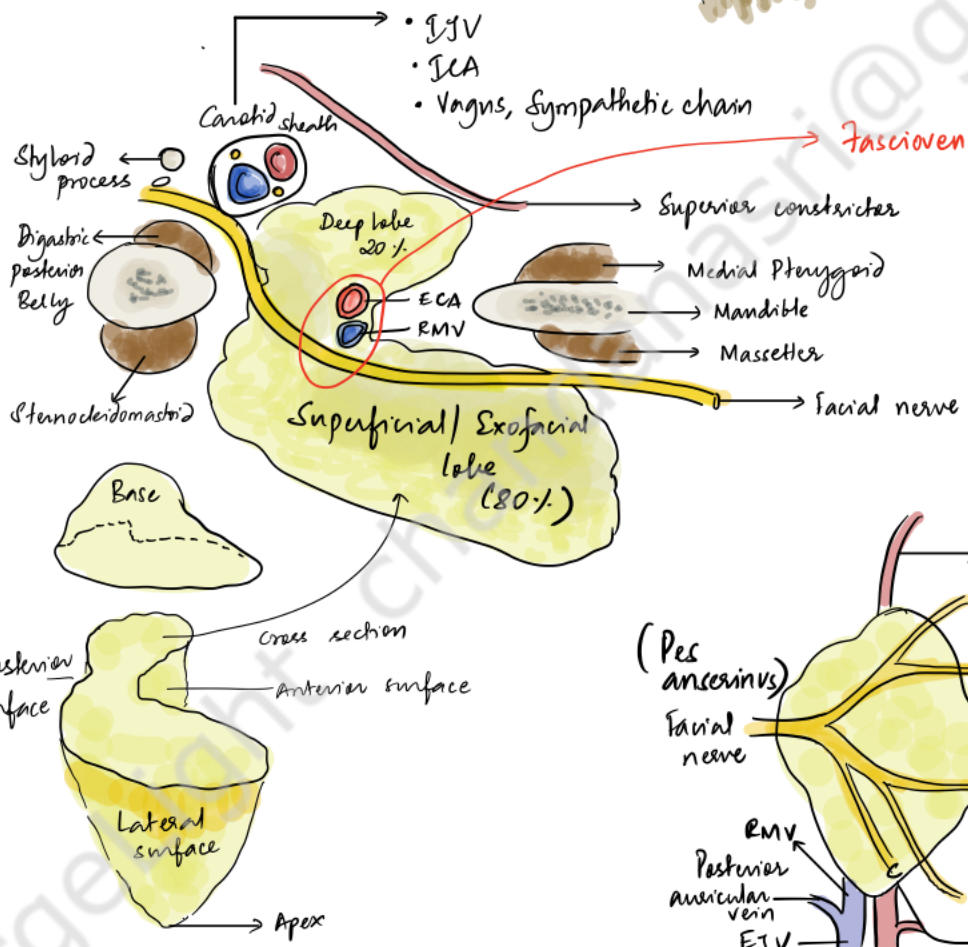
ANATOMY (Ref : Mastery of Surgery - Fischer - 7E)

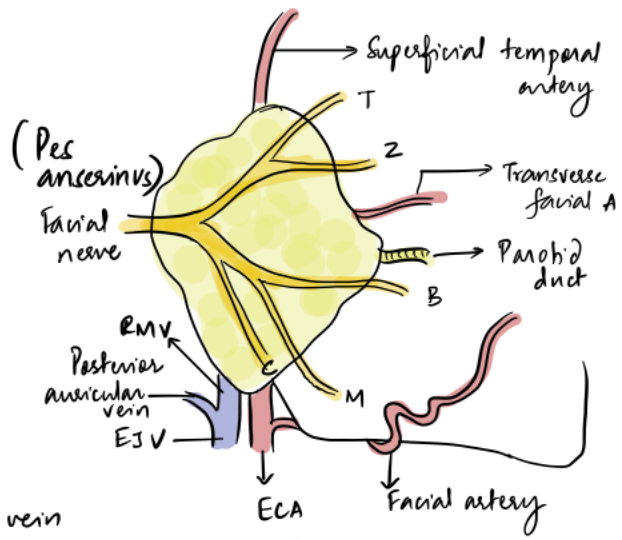
PAROTID GLAND

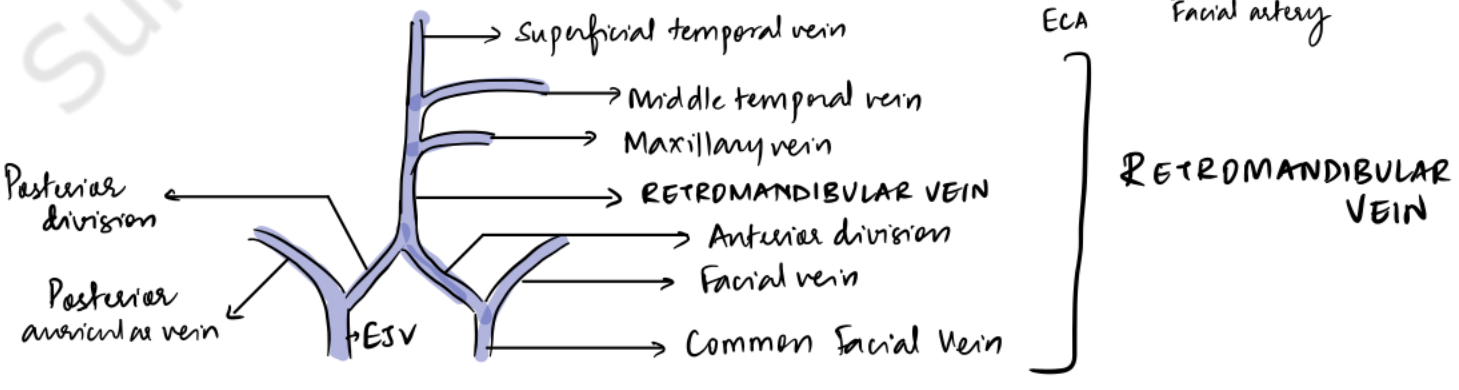
- Largest of the paired salivary glands
- Situated in the parotid space

Anteriorly : Mandibular ramus
Medially : Styloid process
Posteriorly : Mastoid process
Posterosuperiorly : EAC, TM



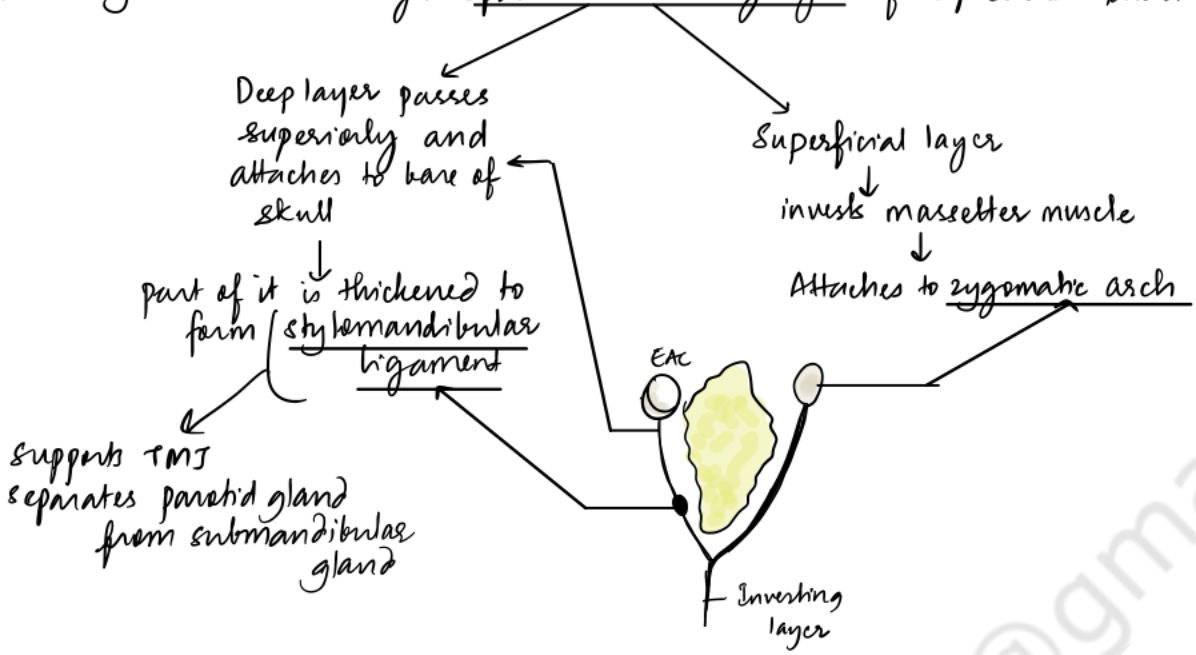






FASCIAL RELATIONS

Parotid gland is encased by a split in the investing layer of Deep Cervical Fascia



Skin over parotid gland is supplied by – Greater auricular nerve
Auriculotemporal nerve

PAROTID DUCT / Stenson's duct – enveloped by the deep lobe of the parotid – only small ductules connect superficial lobe & duct

https://onlinelibrary.wiley.com/doi/abs/10.1002/ca.20011

- ~5cm long
- lies on the superficial surface of the masseter ~1cm below the zygomatic arch
  (Transverse facial artery is interposed between duct & arch)
- when the duct reaches the anterior margin of the masseter, it turns sharply, pierces the BUCCINATOR
  ↓
  terminates in the vestibule of oral cavity opposite the UPPER 2ND MOLAR

NEUROVASCULAR RELATIONS

Superficial ↓ Deep

Nerve
Vein
Artery

ARTERIAL PLANE: ECA enters parotid space after passing deep to digastric (Post belly)

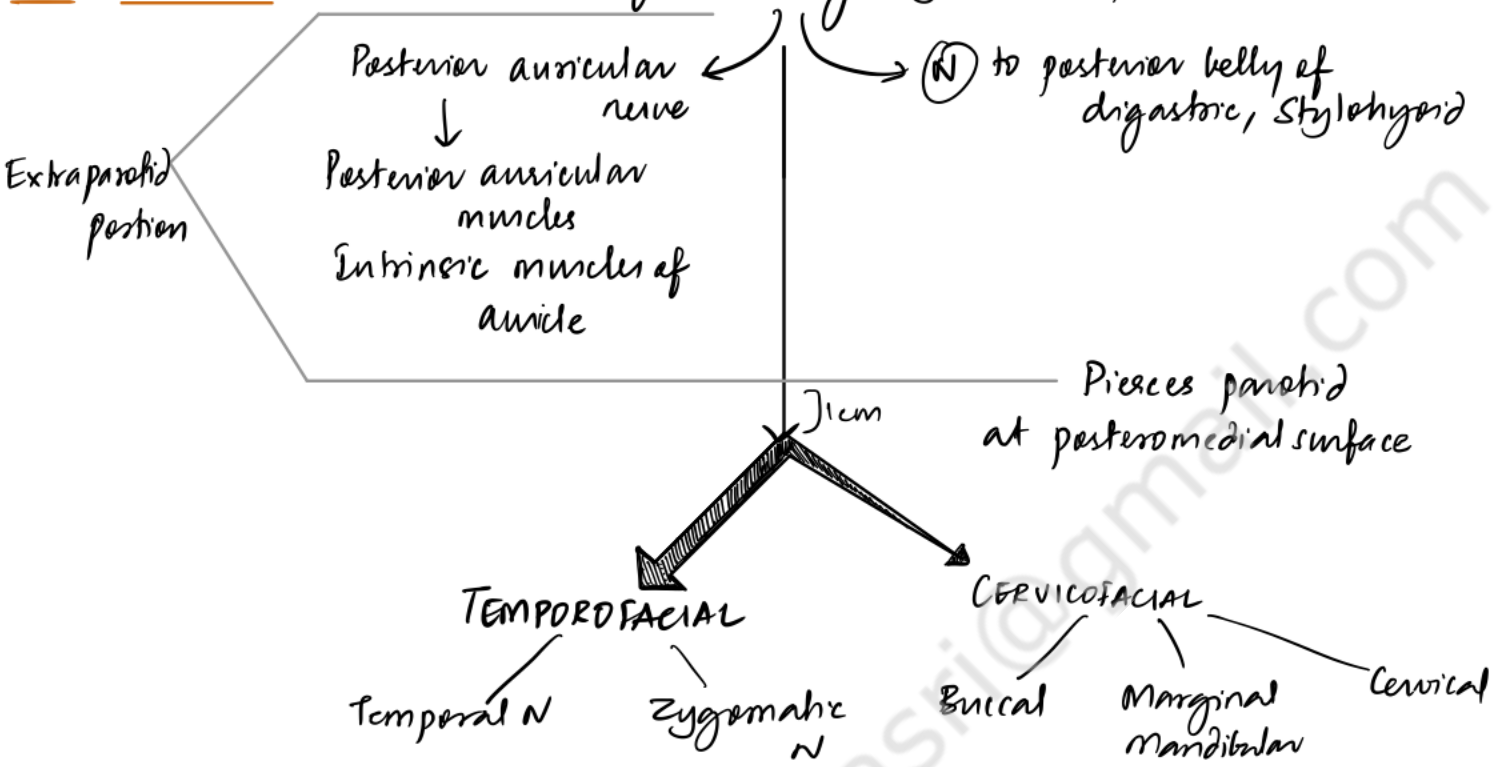
→ gives off posterior auricular artery
→ Stylohyoid branch
↓
Enters stylohyoid foramen
→ lies superficial to Facial nerve

Pierces medial surface of parotid gland

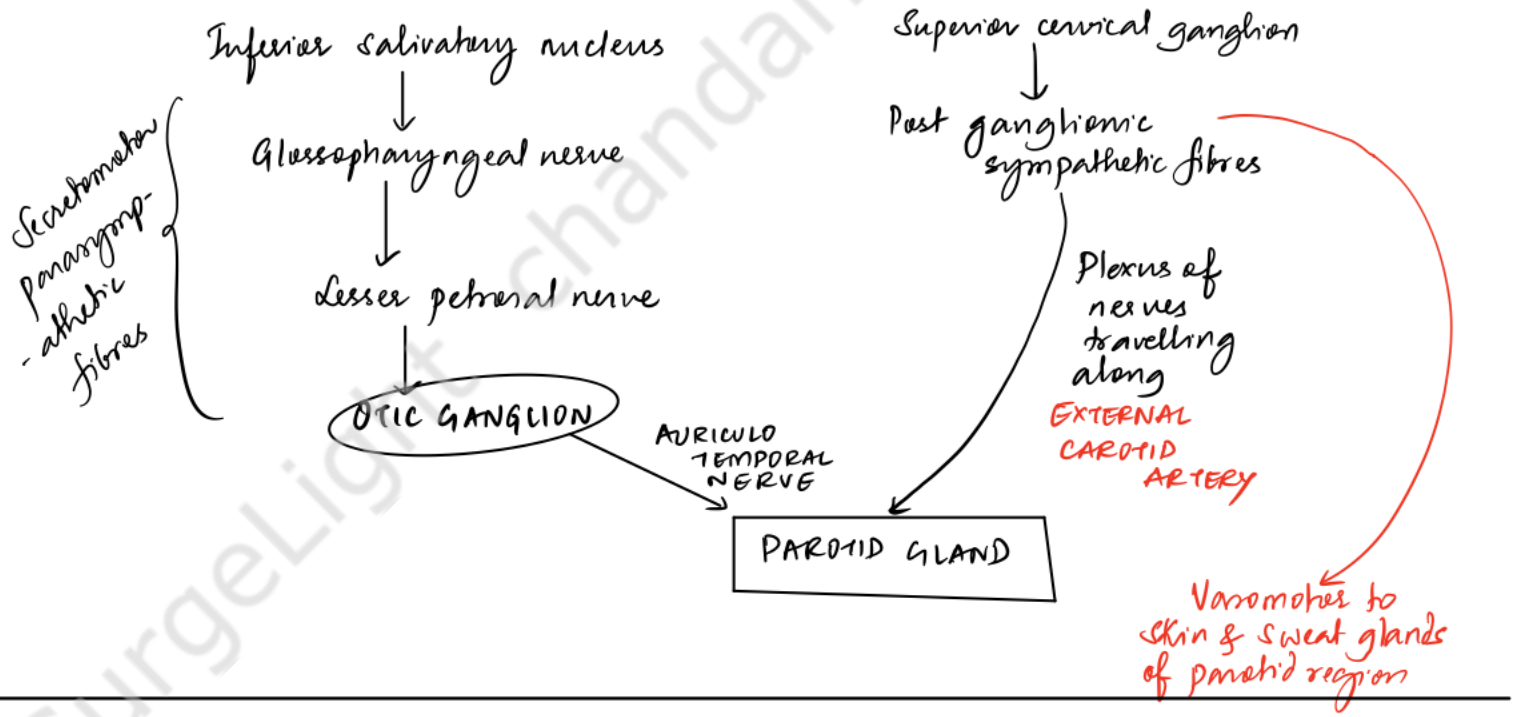
AT MANDIBULAR CONDYLE
→ terminal branches → STA
→ MA

VENOUS PLANE - Superficial to arterial plane → includes RMV & its branches

NERVE PLANE → Facial nerve - after exiting Stylomastoid foramen



AUTONOMIC INNERVATION



LYMPHATIC DRAINAGE

Preauricular nodes → Superficial nodes in superficial fascia → drain into superficial system of cervical nodes along EJV → SUPRACLAVICULAR NODES

Nodes → outside gland but beneath fascia 'SUBPAROTID NODES'

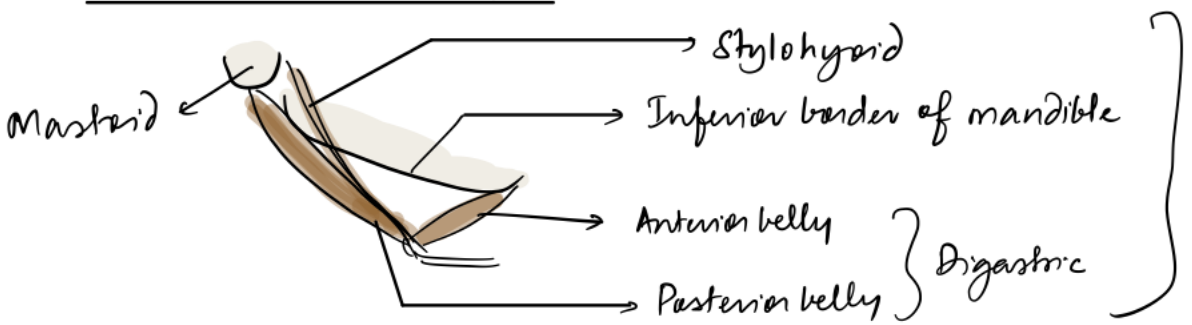
Nodes within parotid fascia → Deep cervical nodes → Jugular chain

There are several lymphoid follicles & 4-10 lymphnodes in the substance of the parotid gland (LNs along posterior facial vein & EJV)

SUBMANDIBULAR GLAND

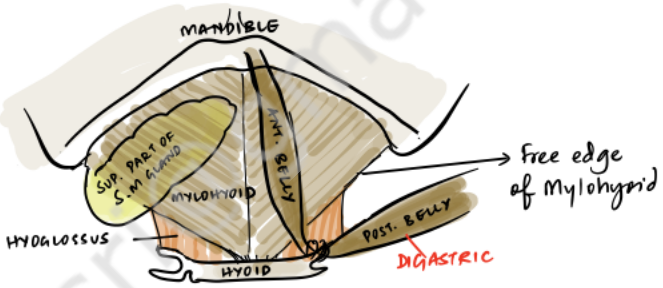
Lies in the submandibular (digastric) triangle

SUBMANDIBULAR TRIANGLE



Muscular floor

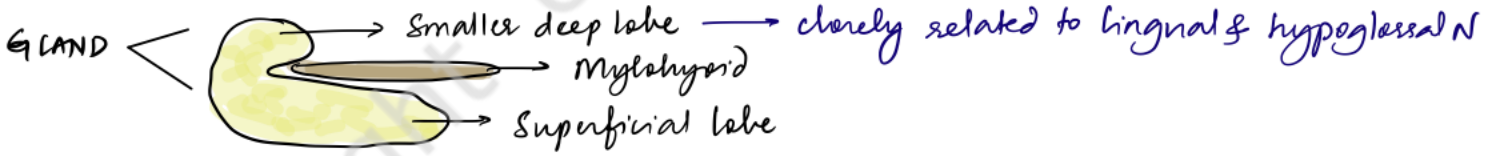
1) Mylohyoid
2) Hyoglossus
3) Inferior portion of Superior constrictor
4) Superior portion of inferior constrictor



Fascial coverings

Fascial roof → investing layer of deep cervical fascia
↓
splits to enclose submandibular gland

- Superficial layer → attaches to inferior edge of mandible
- Deep layer → inner aspect of mandible just below attachment of mylohyoid



closely related to lingual & hypoglossal N

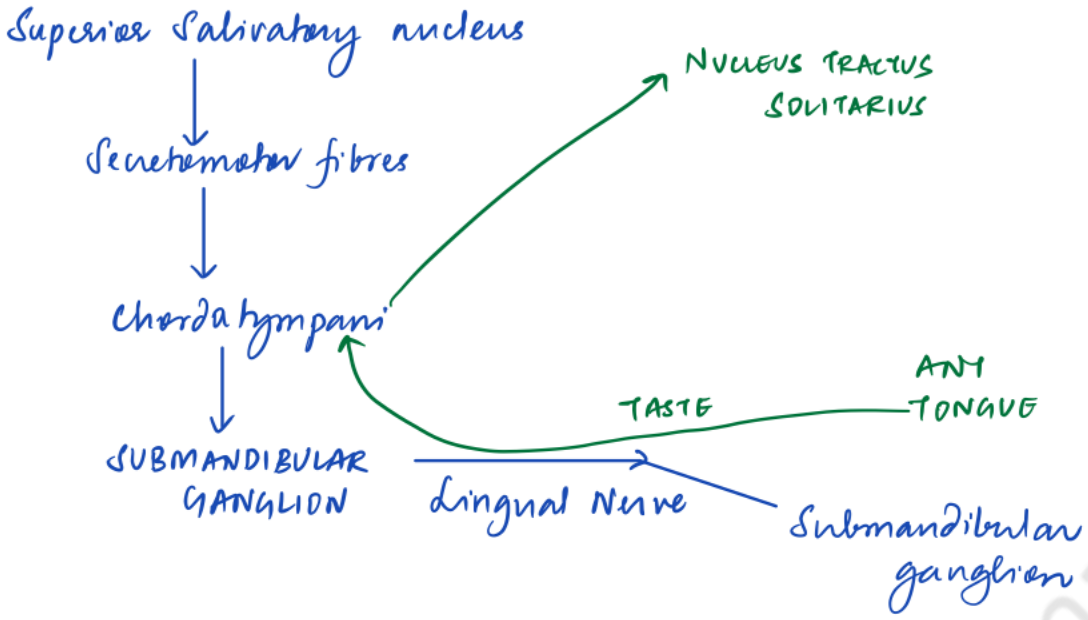
Submandibular / Wharton's duct - passes medial to deep lobe & ends in floor of mouth lateral to frenulum via sublingual papilla

Neurovascular relations

Superficial to Submandibular gland –
1) Cervical branch of facial nerve
2) Distal end of anterior facial vein
3) Anterior branch of RMV

Between Submandibular gland & Mylohyoid
1) Facial artery
2) Mylohyoid nerve
3) Mylohyoid vessels

Lingual nerve passes through interval between HYOGLOSSUS & MYLOHYOID
turns medially, loops around submandibular duct
supplies tongue → general sensation over ant ⅔rds



LYMPHATIC DRAINAGE

Horizontal & vertical systems → deep cervical nodes along IJV
↓
Level II

SUBLINGUAL GLAND

- found in the floor of the mouth between Geniohyoid and Mandible
- Smallest of the paired salivary glands
- Ducts
  - Multiple ducts which directly empty into floor of mouth
  - Ducts which drain into Submandibular duct

Submandibular duct
Lingual nerve
Lingual veins
Hypoglossal nerve
} Medial to Sublingual gland

MINOR SALIVARY GLANDS

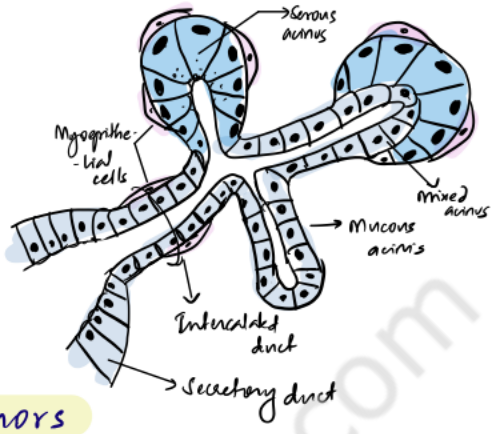
→ Oral mucosa contains ~800 minor salivary glands
↳ LIPS, CHEEK, PALATE, FOM, RMT
→ other areas – upper aerodigestive tract – oropharynx
larynx
trachea
sinuses

} Mucus secreting
- Contribute ~10% of salivary volume

SALIVARY GLAND TUMORS

Cells in salivary glands:

- STROMA
- PARENCHYMA
  - (Acinar) Secretory
    - Serous cells
    - Mucous cells
  - Non Secretory
    - Myoepithelial cells
    - Oncocytes → large spherical cells rich in mitochondria seen in old age
  - Ductal
    - Secretory
      - Intercalated
      - Striated
    - Excretory
    - Main



WHO classification of Salivary Gland tumors

① EPITHELIAL TUMORS

ADENOMA

1) Pleomorphic adenoma
2) Monomorphic adenoma
   - Adenolymphoma - Warthin's tumor
   - Oncocytoma
   - Basal cell adenoma
   - Canalicular adenoma
   - Myoepithelioma

CARCINOMA

LOW GRADE

- Low grade mucoepidermoid carcinoma
- Acinic cell carcinoma

HIGH GRADE

- High grade mucoepidermoid Ca
- Adenoid cystic carcinoma
- Squamous cell carcinoma
- Carcinoma ex pleomorphic adenoma
- Adenocarcinoma
- Anaplastic carcinoma
- Malignant Lymphoepithelioma (ESKIMOMA)

Non epithelial
Hemangioma, Neurofibroma, Lymphangioma, Neurilemmoma

Lymphomas
- 1° - NHL
- 2° - Lymphoma in Sjogren's S°

Secondaries
- Local - H & N
- Distant - skin, bronchus

Unclassified Tumor-like lesions

Solid
- Benign adenomatoid hyperplasia
- Benign lymphoepithelial lesion

Cystic
- Salivary gland cysts

AJCC 8- Staging of tumors of Major Salivary Glands

T
- Tx - can't be assessed
- T0 - no e/o 1°
- Tis - in situ
- T1 - ≤2cm, no extraparenchymal extension
- T2 - 2-4cm, no extraparenchymal extension
- T3 - >4cm; or any size with extraparenchymal extension
- T4
  - T4a - invades skin, mandible, Ear canal, Facial nerve
  - T4b - invades skull base, pterygoid plates, carotid A

N
- Nx - can't be assessed
- N0 - no regional LN mets
- N1 - single, ipsilateral, <3cm
- N2
  - N2a - single, ipsilateral 3-6cm
  - N2b - multiple, ipsilateral <6cm
  - N2c - B/L / contralateral <6cm
- N3
  - N3a - >6cm
  - N3b - ENE+ in any node

M
- M0 - No distant mets
- M1 - Distant mets (+)

STAGE GROUPING

0	Tis	N0	M0
I	T1	N0	M0
II	T2	N0	M0
II	T3	N0	M0
II	T0,1,2,3	N1	M0
IVA	T4a	N0,1	M0
IVA	T0-4a	N2	M0
IVB	Any T	N3	M0
IVB	T4b	Any N	M0
IVC	Any T	Any N	M1

- m/c site of salivary gland tumors - Parotid - ~70% salivary gland tumors
  10-20% - Minor salivary glands
  8-10% - submandibular glands
  <1% - Sublingual glands

- 80% benign - 20% malignant

- 90% Minor salivary gland tumors are malignant ; 50% submandibular-Malig

- Rule of 80's : 80% parotid tumors - BENIGN
  80% parotid tumors - Pleomorphic adenomas
  80% salivary pleomorphic adenomas - parotid
  80% parotid pleomorphic adenomas - superficial lobe

Salivary neoplasms - only 3-4% of all Head and neck neoplasms

PAROTID TUMORS

- Parotid - m/c site for salivary tumors
- m/c arise in superficial lobe - 'below, behind & in front of ear → upper neck'
  - lifts up ear lobule
  - 'Curtain sign'
- Limited mobility, fixity to skin / bone → f/s/o malignancy
- Deep lobe - parapharyngeal mass → difficulty in swallowing, snoring (Retrotonsillar)
- Facial nerve palsy - rare presenting complaints → indicates malignancy
- Advanced malignancies invading parapharyngeal space → affect CN IX to XII → sympathetic chain
- Mandibular nerve involvement - when tumor tracks along auriculotemporal nerve to skull base. → pain

Investigations

- USG - initial assessment, for guided FNAC
- CT - cortical bone involvement
- MRI - Deep lobe extension, marrow infiltration, perineural spread, facial nerve
  MR spectroscopy - Benign vs Malignant ; Pleomorphic adenoma vs Warthin's
- FNAC

BENIGN TUMORS

PLEOMORPHIC ADENOMA

- m/c salivary gland tumor
- ~5th decade
- F > M
- Superficial lobe
- Aneuploidy

- "Mixed tumor"
- Dual origin

Epithelial cells	Myoepithelial cells
↓	↓
Polygonal / spindle shaped / stellate cells in ducts / sheets / clumps	Stromal matrix of mucoid / myxoid / hyaline material

- areas of squamous metaplasia
  epithelial pearls
- Fibrous pseudocapsule
- Pseudopodia → extensions of the tumor into glandular parenchyma as finger like projections
  → Recurrence

Risk of malignant transformation to CARCINOMA Ex PLEOMORPHIC ADENOMA (Malignant Mixed Tumor)
(9.5% risk in 15y - ↑ over time)

Management

Surgery - TOC - Superficial parotidectomy
Total parotidectomy
Extracapsular Dissection is non-inferior in managing benign tumors ∵ ↓ incidence of Frey's & facial palsy

Enucleation - recurrence rate of 20-45%

WARTHIN'S TUMOR

Syn: Papillary Cystadenoma Lymphomatosum / Monomorphic adenoma / Adenolymphoma

Theories

1) Develops from HETEROTOPIC SALIVARY DUCTS trapped within INTRAPAROTID / PARAPAROTID lymphoid tissue
2) Epithelial proliferation → incites a concomitant lymphocytic response → Suggests NON-INTRANODAL OCCURENCE

- 2nd most common salivary gland tumor, Malignant change < 1%
- m/c Bilateral tumor
- m/c site is parotid → tail of parotid; ~10% → deep lobe
- M > F; SMOKERS; older age, obesity
- Warthin's tumor concentrates Tc 99m → Scintigraphy feasible (Oncocytomas also)

APPEARANCE: Cysts: lined by papillary proliferation of bilayered oncocytic epithelium ∴ basaloid cells
Stroma ∴ lymphocytes → ∴ germinal centres & mantle zones

Rx - Superficial parotidectomy (Recurrences almost unknown)

MALIGNANT TUMORS

MUCOEPIDERMOID CARCINOMA

m/c salivary malignancy (35-40% of all salivary malignancies)
50% occurs in major salivary glands

m/c parotid malignancy

Appearance

Epidermoid cells | Mucin producing cells | Intermediate cells

Multicystic & solid components

GRADES – LOW/ INTERMEDIATE/HIGH

↓

Based on

1) Necrosis – 2
2) Neural invasion – 2
3) Anaplasia – 4
4) >4 mitoses/hpf – 3
5) < 20% cystic – 2
(More solid → high grade)

0-4 → low grade
5, 6 → Intermediate
≥ 7 → High grade

Rx: low grade -
Sup/Total Conc parotidectomy
High grade:
Parotidectomy + ND + RT

ADENOID CYSTIC CARCINOMA

- 2nd m/c salivary malignancy
- m/c malignancy of minor salivary glands

~22% of salivary gland tumors

Perineural spread ⊕

Hematogenous spread ⊕

↓ lymphatic spread (~10-25%)

Long indolent period & sudden spikes of growth

HISTOLOGY

Classic/ Cribriform | Tubular | Solid/ Basaloid (m/c recurrence)

Grade -
Low - Cribriform/ tubular
Intermediate - 30-70% Solid
High - >70% solid

5-6th decade
M > F
slow growing but aggressive

Rx:

Total radical/ conservative parotidectomy

ADENOCARCINOMA

Acinic cell carcinoma | Polymorphous low grade adenocarcinoma | NOS

Polymorphous low grade adenocarcinoma → a/k/a Pleomorphic adenoma

NOS
- m/c variant
- invasive & aggressive

1) Indolent low grade neoplasms

2) Women > Men

3) Variant:
- microcystic (m/c)
- Papillary
- Follicular
- Medullary

Rx:

Superficial / Total conservative/ Radical parotidectomy

Squamous cell carcinoma - m/c - deposits from SCC elsewhere (metastatic)
m/c site of 1° - Temporal region

Anaplastic carcinoma - appears late in life
- behaves aggressively

PAROTID SURGERIES

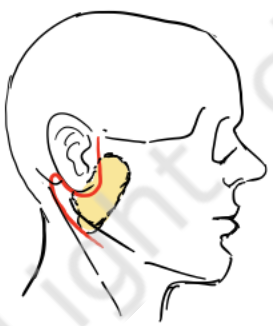
- Based on extent of Parenchymal excision

- Superficial parotidectomy
  - Partial
    - Extracapsular dissection ('WLE' ± 1cm margin)
  - Complete
- Total Parotidectomy

- Based on attitude towards facial nerve

- Conservative
  - Facial nerve & all its branches are preserved
- Semiconservative
  - Some branches of facial nerve are preserved
- Radical
  - Facial nerve is sacrificed
  - → Extended radical parotidectomy
    - In addition to CN VII, the following are removed
      - Skin
      - Infratemporal fascia
      - TMJ
      - Mandible, Masseter
      - Petrous temporal bone

① INCISION



Modified Blair / Lazy-S incision

- Preauricular - mastoid - cervical incision
- Skin flap raised - anteriorly, just above the plane of parotid fascia upto anterior border of the gland
  - posteriorly upto anterior border of SCM

② MOBILIZATION OF THE GLAND

2 avascular planes

Along anterior border of SCM - upto anterior aspect of mastoid till posterior belly of digastric seen

- Elective transection of Greater auricular nerve
- Post. auricular N preserved

Along anterior border of body and cartilaginous EAM immediately anterior to tragus

Connected to free the posterior margin of the gland to allow identification of facial nerve trunk

③ IDENTIFICATION OF THE FACIAL NERVE TRUNK

Anterograde method (Trunk → Branches)

↓

Identification of the nerve trunk after its exit from stylomastoid foramen

LANDMARKS

1) CONLEY'S TRAGAL POINTER - inferior portion of the cartilagenous canal
   - facial nerve lies 1cm deep and inferior to the tip
2) Upper border of POSTERIOR BELLY OF DIGASTRIC
   - immediately superior
3) SQUAMOTYMPANIC FISSURE
4) STYLOID PROCESS - facial (N) is superficial to it
5) MASTOID PROCESS - drilled to ID the nerve more more proximally

Retrograde method (Branches → Trunk)

↓

useful in cases of reoperation and post RT status i/c/o extensive fibrosis in surgical field

↓

One of the main branches is identified and traced upto the trunk

1) Buccal branch - in relation to the parotid duct
2) Marginal mandibular branch in relation to facial vessels

Watch for bleeding d/t injury to stylomastoid artery (immediately lateral to the nerve)

④ DISSECTION OF GLANDULAR TISSUE OFF THE FACIAL NERVE

Dissect in the perineural plane immediately over the nerve

↓

Create a 'tunnel' → lay it open → proceed from trunk to periphery

Except for buccal branch, any other branch, if transected, must be repaired immediately ć a cable graft from greater auricular nerve

⑤ CLOSURE : suction drain

COMPLICATIONS OF PAROTID SURGERY

- Hematoma
- Sialocele / Seroma
  Raw gland surface - collection of saliva / leakage of saliva from wound

  Rx - Drainage
  - Pressure dressing
  - Botox → ↓ release of acetylcholine from post-ganglionic parasympathetic fibres

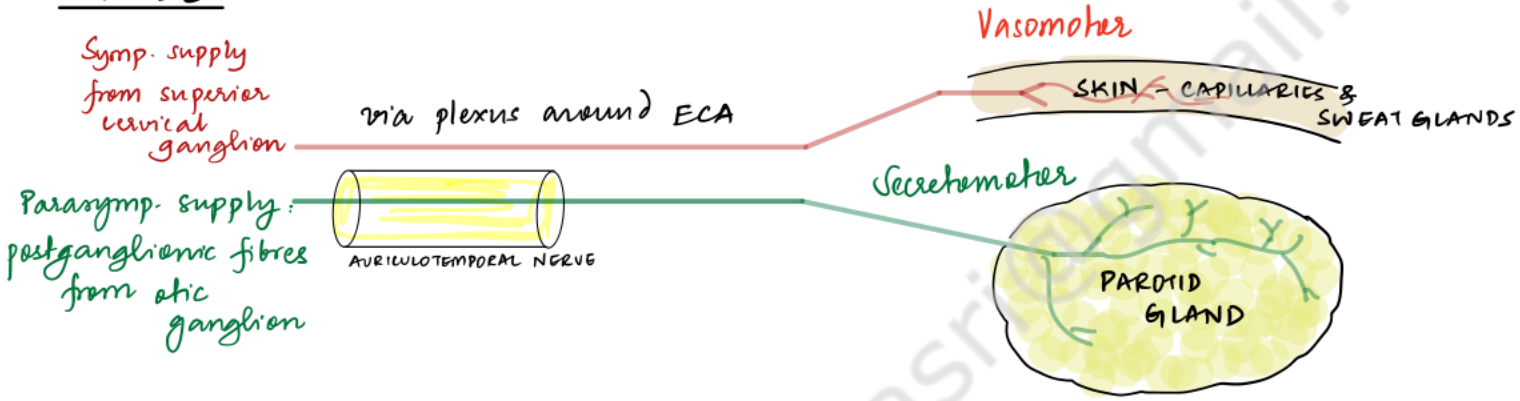
- Deformity - facial scar, retromandibular hollowing (can be remedied)
  - by local rotation of the posterior belly of digastric
  - by abdominal fat graft
- Ear lobe numbness - d/t injury / sacrifice of Greater auricular nerve
  - may decrease over time
- Facial numbness - cutaneous denervation due to extensive raising of thin flaps
- Infection
- Flap necrosis
- FACIAL NERVE INJURY
- FREY'S SYNDROME
- Recurrence

FREY'S SYNDROME

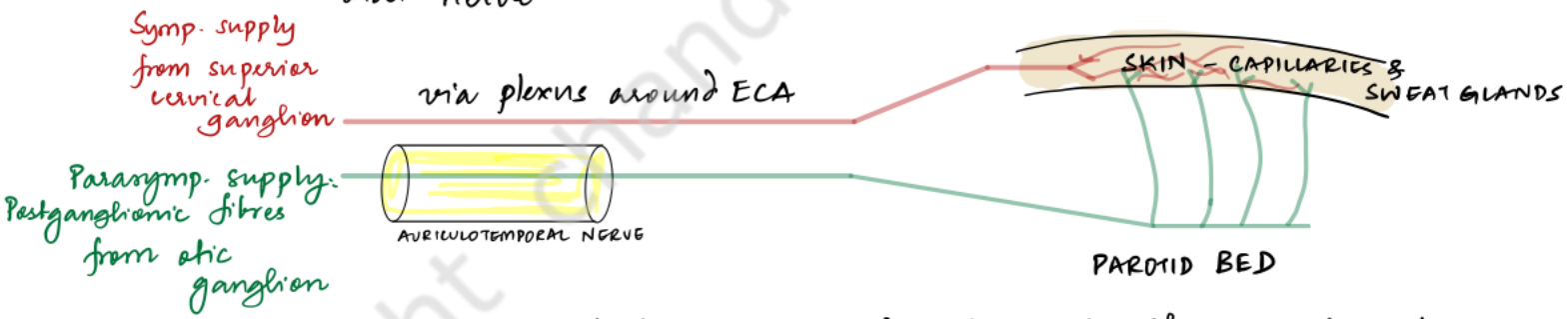
'Gustatory sweating' - sweating & erythema over the parotid region upon sight, smell and taste of food (autonomic stimulation)

- results from damage to autonomic innervation of parotid gland with inappropriate regeneration of post-ganglionic parasympathetic nerve fibres of the auriculotemporal nerve, that aberrantly stimulate the overlying skin

NORMAL



S|P PAROTIDECTOMY - abnormal innervation of the skin overlying the parotid gland by the parasympathetic fibres in auriculotemporal nerve



Whatever normally stimulates the secretomotor activity in the parotid gland (enabled by parasympathetic innervation) also stimulates the skin & sweatglands over the parotid area

incidence - ~2-80%

incidence of Frey's syndrome is minimal if extracapsular dissection as the parotid fascia is primarily repaired & communication between denuded parenchyma & subcutis is prevented.

Diagnosis - STARCH-IODINE test
- Parotid area is painted with iodine - allowed to dry
- Dusted with dry starch - turns blue on sweating

MANAGEMENT OF FREY's SYNDROME

PREVENTION

Creation of a barrier between the parotid bed & subcutis
↓
minimize inappropriate nerve regeneration

1) Sternomastoid muscle flap
2) Temporalis fascia flap
3) Insertion of artificial membranes such as ACELLULAR DERMIS

TREATMENT

TOPICAL

Antiperspirants

Aluminium chloride

Anticholinergics

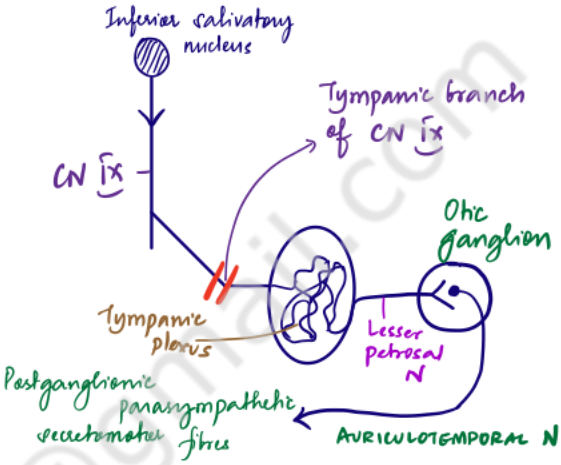
- Scopolamine
- Glycopyrrolate

LOCAL

1) BOTOX injection to affected skin
2) Irradiation of the affected area

SURGICAL

TYMPANIC NEURECTOMY



ECTOPIC SALIVARY GLANDS (from pathology outlines.com)

- Heterotopia / Ectopia of Salivary Glands
- presence of normal salivary gland tissue at a site where it is not normally present
- usually in head & neck
- Due to • abnormal persistence & development of salivary gland rests along embryologic pathways
  - • salivary differentiation of primitive embryological structures
- May suffer the same pathological processes as usual salivary tissue
- m/c tumor in ectopic salivary gland - Warthin's tumor

TYPES

INTRANODAL

- in infants, most nodes within / near parotid gland contain salivary gland tissue (in esp. medullary portion of the nodes)

EXTRANODAL

High

- Mandible (Angle of mandible)
  - ↓
  - Static Bone Cyst
    - ↳ m/c ectopic salivary gland
- Mastoid
- External & middle ear
- Tonsil
- Mylohyoid
- Gingiva

Low

Related to Branchial pouches in lower neck

- Thyroid / Parathyroid
- near sternoclavicular joint

MAXILLOFACIAL TRAUMA

ABC

Airway - lateral position & sit & lean forward } to prevent airway obstruction by blood or dental fragments

Midface # ± Mandible #

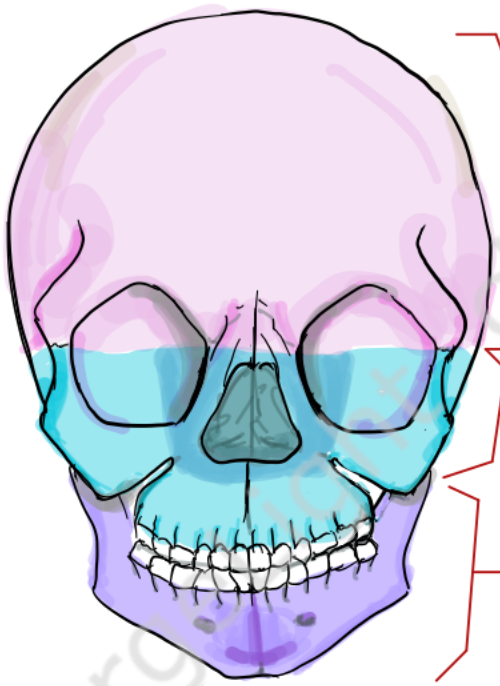
→ Maxillary segments } displaced downwards & backwards
→ tongue

→ Disimpact & pull forward
→ fix & clip/suture

→ Secure airway by intubation / Surgically

Bleeding - midfacial # - nasal / pterygoid plexus

BONY INJURIES AND FRACTURES



PARTS OF THE FACIAL SKELETON

→ UPPER FACE - above the level of canthi

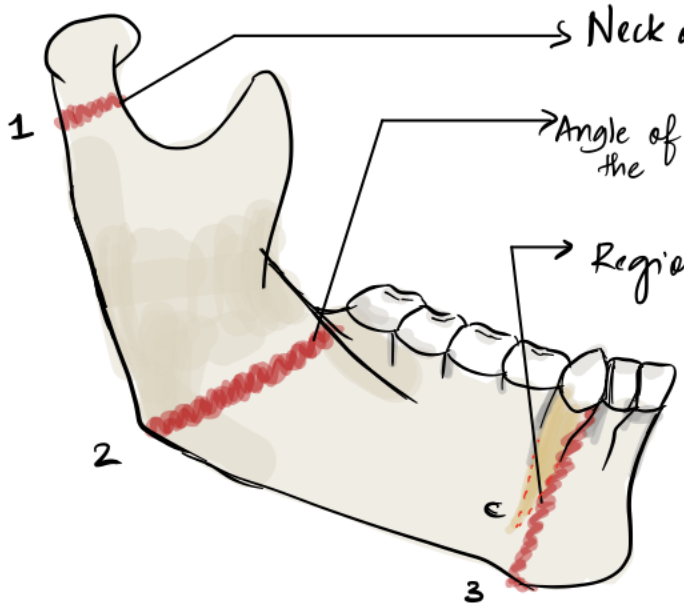
→ MIDFACE
- Central - Naso-orbito ethmoidal complex
- Lateral - zygomaticomaxillary complex

→ LOWER FACE - mandible

CRANIOFACIAL FRACTURES - Skull # + Facial #s
- #s extending into frontal / ethmoidal sinuses

PANFACIAL FRACTURES - #s involving all levels of the face

MANDIBULAR FRACTURES



} → uninterrupted 3rd molar can weaken bone

long tooth can weaken the area

Clinical Features

- Dental malocclusion
- Step deformity
- Floor of the mouth ecchymosis
- Inferior lip & chin tingling - Inferior alveolar nerve entrapment/injury
- EAC bleeding - Condylar fracture

Evaluation - OPG / Xray : PA, lateral & Occlusal view
- CT - Coronal plane

Rx - Surgical realignment (to mitigate malocclusion & osteomyelitis)
- Intermaxillary fixation (IMF) - wiring
- ORIF : plate & screws
  - load sharing / smaller #s
  - load bearing / larger #s
  - 2mm - monocortical
  - 2.7mm - for larger #s, bicortical fixation may be required
- Edentulous jaws - Gunning splint

FRACTURES OF ZYGOMATICOMAXILLARY COMPLEX (ZMC) - Tripod #s

Bony Buttresses of the face

HORIZONTAL BUTTRESSES

- Cross-member stability to facial skeleton
- AP + horizontal dimensions of face

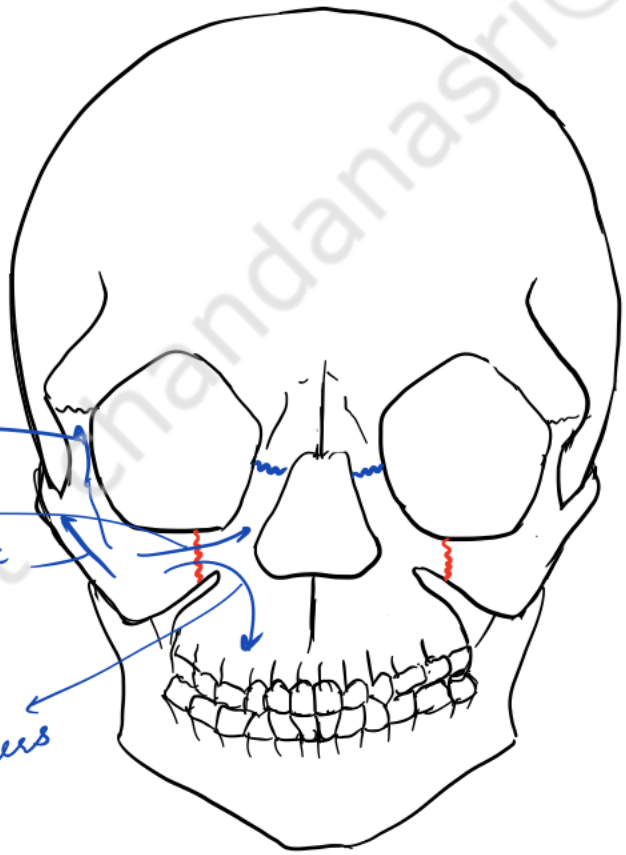
1) Frontal bar
2) Zygomatic arch + zygomatic bone + infraorbital rim
3) Palatal + mandibular arch

VERTICAL BUTTRESSES

- Define the vertical height of the face
- Support mastication

1) Nasomaxillary
2) Zygomaticomaxillary
3) Pterygomaxillary
4) Ramus of mandible

"4-legged stool"



1/2/3/4 point fixation

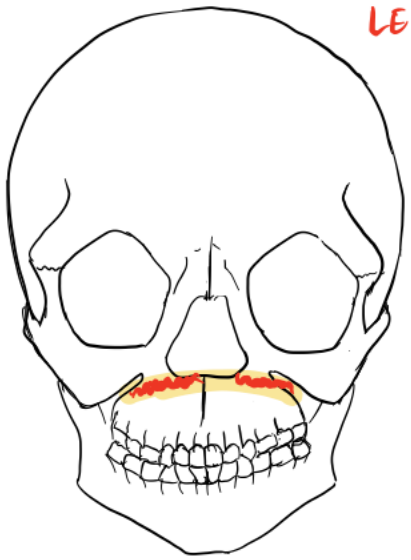
Almost all ZMC # involve bony orbit

- Periorbital ecchymosis
- Subconjunctival hemorrhage
- Bony steps
- Altered sensation along the infra-orbital nerve distribution

uncomplicated ZMC #s - treated within 10d of #

Isolated undisplaced zygomatic arch #s - can be managed conservatively

MAXILLARY - LE FORT FRACTURES



LE-FORT-I / GUERIN # / DENTOALVEOLAR DISJUNCTION

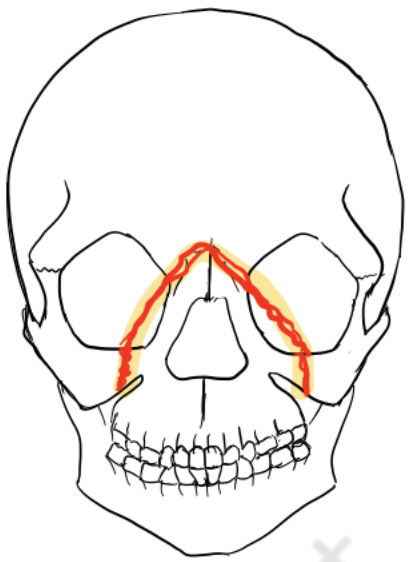
'Floating palate' - mobile fragment

also involves lower nasal septum

a/i upper lip lacerations

malocclusion

℞ - IMF
ORIF



LE-FORT-II - PYRAMIDAL # OF MIDFACE

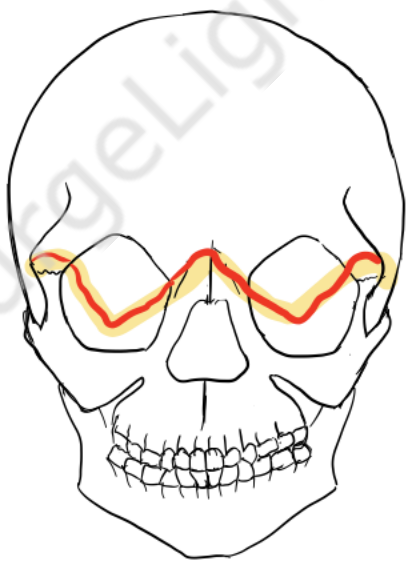
Midface deformity ☹

Epistaxis ++, nasal airway compromise

step defect in inferior orbital rim

Infra-orbital nerve involvement

- IMF + tracheostomy



LE FORT-III - CRANIOFACIAL DISJUNCTION

- Massive facial edema, ecchymosis
- elongated face, lateral orbital rim defect
- Flattened naso-orbital area
- Epistaxis, CSF rhinorrhea

℞ - ORIF

Bone graft recon of orbital wall & floor

ORBITAL FRACTURES

ORBITAL FLOOR FRACTURES - m/c
- can occur as a part of Le Fort II & III, NF # & ZMC #s

BLOW OUT - isolated orbital floor #

violent anterior impact to globe
↓
Force transmission to orbital cavity
↓
transmitted to floor (weakest wall) → 2nd weakest wall ↓ medial (lamina papyracea)
↓
Herniation of orbital contents into maxillary sinus

Clinical features:
- Entrapment of inferior rectus / inferior oblique → impaired upward mobility, diplopia
- Enophthalmos
- Infraorbital hypo-esthesia
- Malar deformity
- Nose blowing → momentary exophthalmos, orbital emphysema

CT - hanging drop / tear drop sign

Rx - Orbital floor recon (autologous bone / alloplastic implant)
Antral packing

BLOW IN - Orbital roof fractures
a/w frontal sinus & nasoethmoidal fractures
involvement of superior rectus ± superior oblique
↓
loss of upward gaze

NASO-ORBITO ETHMOIDAL FRACTURES

Central upper midface #s ⇒ significant force transfer

- Depressed nasal bridge
  +
- Telecanthus (traumatic - due to detachment of medial canthal ligament)
- CSF rhinorrhea

℞ - ORIF + Canthopexy

BRANCHIAL CYST / SINUS / FISTULA

- fluid filled lesion which develops from the vestigeal remnants of BRANCHIAL CLEFTS (m/c → 2nd)
- lined by squamous epithelium
- contains turbid fluid - cholesterol crystals - non transilluminant usually

℞ - complete excision

EMBRYOLOGY

Branchial apparatus - develops during 2nd to 6th weeks of fetal life

2nd arch grows caudally & covers the 2nd, 3rd & 4th clefts

↓

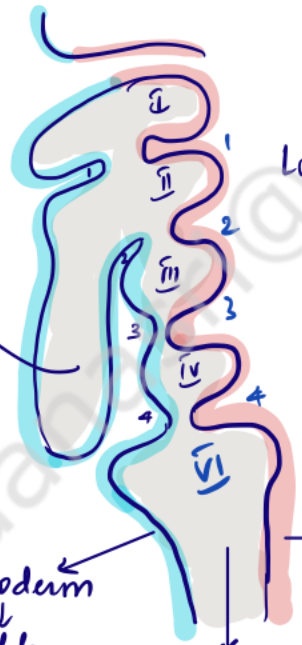
Common groove

↓

Cervical sinus of His (lined by ectoderm)

↓

Obliterates



Failure to obliterate

↓

BRANCHIAL CYST

Drainage → BRANCHIAL SINUS ← ACQUIRED 2/t I & D

\+

Breakdown of endoderm of 2nd branchial pouch

↓

BRANCHIAL FISTULA - external opening - lower neck (MID & LOWER THIRD OF ANTERIOR BORDER OF SCM)

- internal opening intratonsillar cleft of palatine tonsil

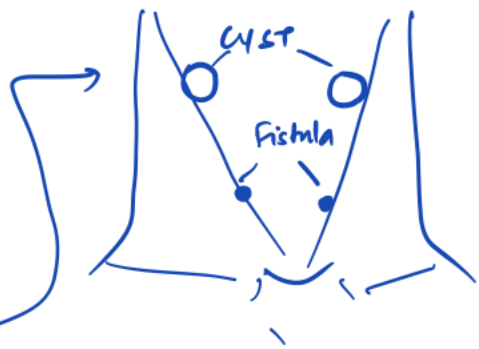
- pierces platysma
- curves medially at the level of hyoid bone
- Passes between ECA & ICA
- Passes close to hypoglossal & glossopharyngeal N
- deep to posterior belly of digastric

BRANCHIAL ARCH DERIVATIVES

Derivates of pharyngeal folds	Arch number	Aortic arch	Cranial nerv	Examples of branchiomeric muscles	Skeletal derivates	Derivates of pharyngeal pouch
external auditory meatus (I)	I mandibular	maxillary artery	V trigeminal	muscles of mastication etc. mylohyoid ABDG, tensor tympani tensor palati	malleus, incus spheno-mandibular lig. Meckel cart.	I middle ear auditory tube
II	II hyoid	hyoid, stapedia artery	VII facial	muscles of facial expression etc. Platysma, SH, PBDG, Stapedius	stapes, styl. proc., stylohyoid lig., part of hyoid cart.	II supra-tonsillar fossa
neck (II)	III	internal carotid artery	IX glosso-pharyng.	m. stylopha-ryngeus	parts of hyoid cart.	III thymus, parathyr. gland
III	IV	right subclavian artery, aorta	X Superior Laryngeal N vagus Recurrent laryngeal N	pharyngeal and laryngeal musculature	laryngeal cart.	IV thymus parathyr. gland ultimobranch. body
IV	VI					

FIRST BRANCHIAL CLEFT CYSTS

- TYPE I → near EAC
- TYPE II → near angle of mandible



SECOND BRANCHIAL CLEFT CYSTS – M/C – 95%

→ along ANTERIOR BORDER OF UPPER 1/3rd of SCM

THIRD

→ Similar to second cyst

→ But fistula → courses posterior to carotids
pierces thyrohyoid membraine
enters larynx
↓
terminates in lateral aspect of PYRIFORM SINUS

FOURTH – very rare – thyroid mediastinum

FASCIAL SPACES AND INFECTIONS OF THE NECK

Fascial layers of the neck
- Superficial cervical fascia
- Deep cervical fascia

SUPERFICIAL FASCIA

- Lies between dermis & deep cervical fascia
- Fat & connective tissue - not very well defined
- Contains:
  - Neurovascular supply to skin
  - Superficial veins – External jugular vein
  - Superficial LNs
  - Fat
  - Platysma

PLATYSMA - Origin - 2 heads — Fascia of Pectoralis major; Deltoid fascia
Insertion - inferior border of mandible
(also attaches to skin & superficial fascia)

Innervation - cervical branch of facial nerve

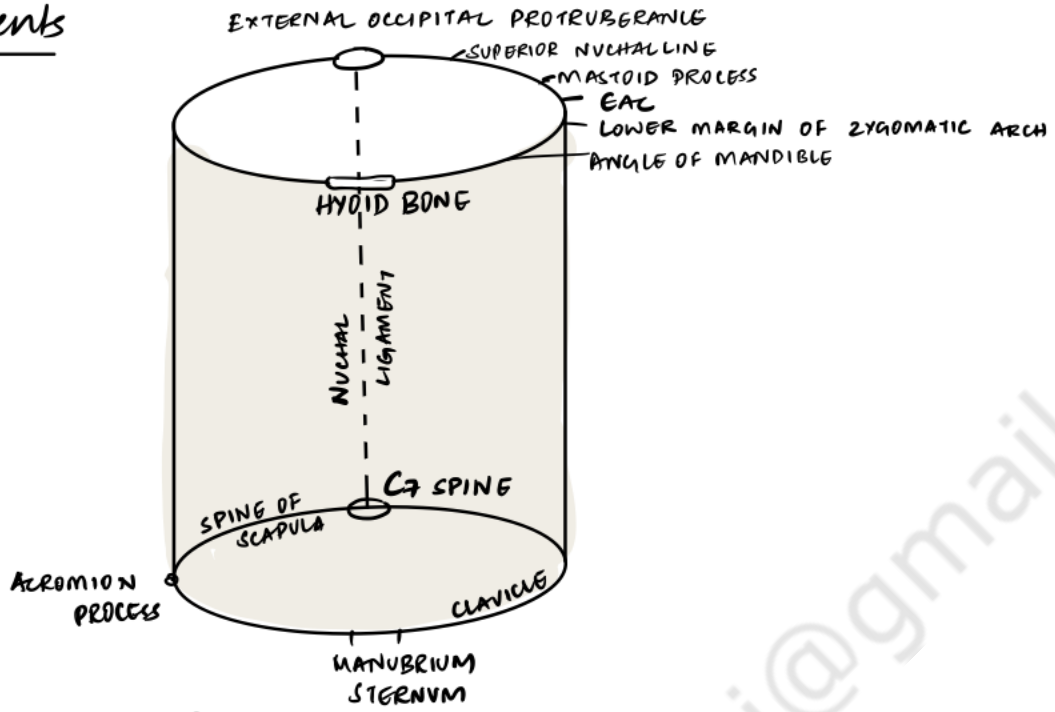
Action: Depresses mandible, angle of mouth
wrinkles skin of neck

DEEP CERVICAL FASCIA / FASCIA COLLI

1) Investing layer
2) Pretracheal fascia
3) Prevertebral fascia

INVESTING LAYER OF DEEP CERVICAL FASCIA

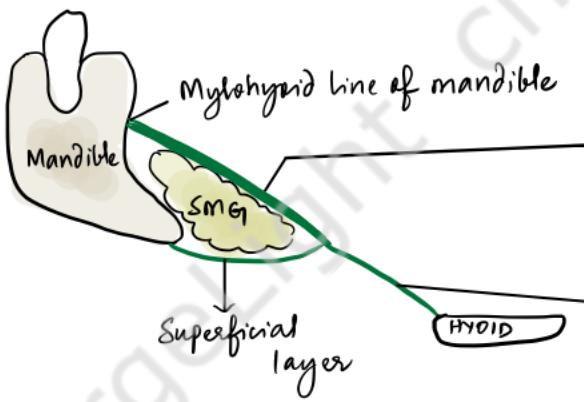
Attachments



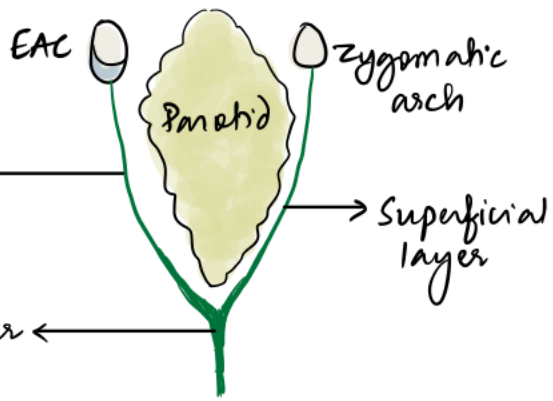
Splits to enclose (2) muscles
1) Sternocleidomastoid
2) Trapezius

Splits to enclose (2) glands above hyoid bone

1) SUBMANDIBULAR GLAND



2) PAROTID GLAND

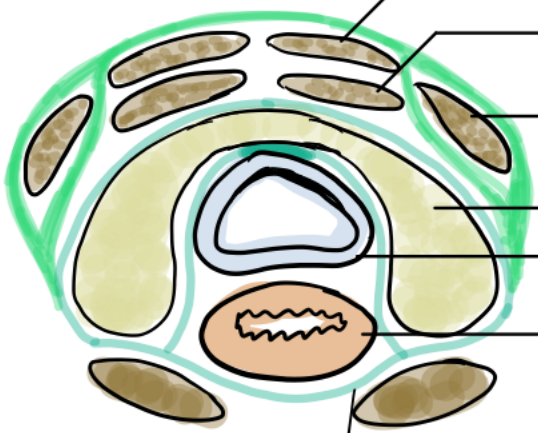


2) DIVIDES TO ENCLOSE (2) SPACES
1) Suprasternal space
2) Supraclavicular space

3) Creates (2) Fascial slings
1) For inferior belly of omohyoid
2) Intermediate tendon of digastric

PRETRACHEAL FASCIA

- spans between HYOID BONE superiorly and THORAX inferiorly
  ↙ fuses i pericardium



Sternohyoid, Sternothyroid → Enclosed by MUSCULAR PART
Omohyoid
Thyroid gland, Trachea → Enclosed by VISCERAL PART
(MUSCULAR PART + VISCERAL PART) of pretracheal fascia

→ Posterior aspect of visceral fascia receives contribution from buccopharyngeal fascia

→ Splits to enclose thyroid gland
↓
Thyroid capsule – connected to oblique line of thyroid cartilage

DEGLUTITION → Thyro & cricopharyngeal part of inferior constrictor contract
↓
Laryngeal elevation
↓
Upward movement of thyroid gland during deglutition

→ Enters thorax in front of trachea to join fibrous pericardium

PREVERTEBRAL FASCIA

- surrounds the vertebral column and associated muscles → scaleni
  → prevertebral muscles
  → deep muscles of back

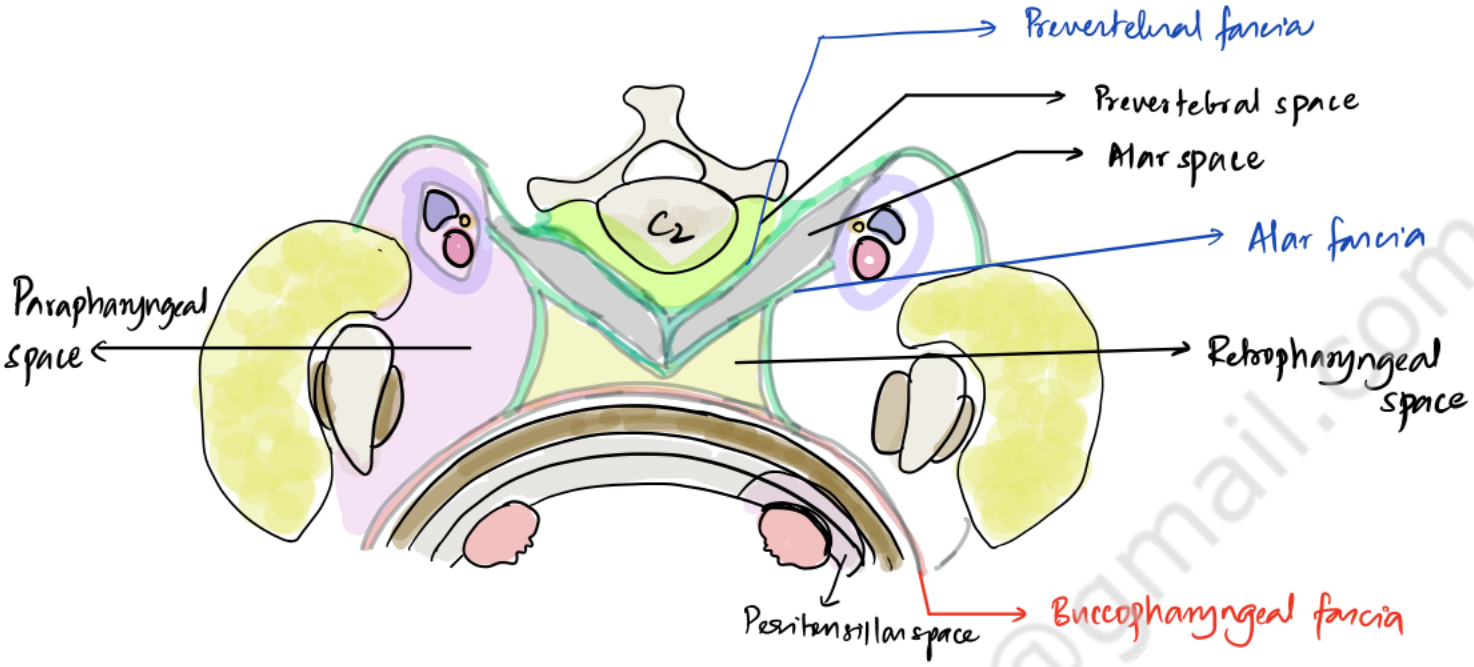
- Attachments
  - Superiorly - base of skull
  - Anteriorly - transverse processes vertebral bodies
  - Posteriorly - nuchal ligament of vertebral column
  - Inferiorly - fuses i endothoracic fascia

- Forms floor of posterior triangle
- Forms AXILLARY SHEATH around brachial plexus

CAROTID SHEATH

- receives contributions from pretracheal, prevertebral and investing layer
- runs from base of skull to mediastinum

SPACES OF THE NECK



1) Superficial space (anteriorly) → Ludwig's angina
2) Retrophayngeal space → Acute retrophayngeal abscess d/t infection of retrophayngeal nodes - paramedian swelling
3) Paraphayngeal space → Paraphayngeal abscess
4) Alar space / Danger space
5) Prevertebral space - Chronic retrophayngeal abscess. TB spine - visible as midline swelling in posterior phayngeal wall

JAW TUMORS

ODONTOGENIC

BENIGN
1) Odontoma
2) Ameloblastoma
3) Cementoblastoma
4) Odontogenic myxoma
5) Ameloblastic fibroma
6) Pindborg tumor

MALIGNANT
1) Odontogenic Ca
   - Ameloblastic Ca
2) Odontogenic Sarcoma
3) Odontogenic Carcinosarcoma

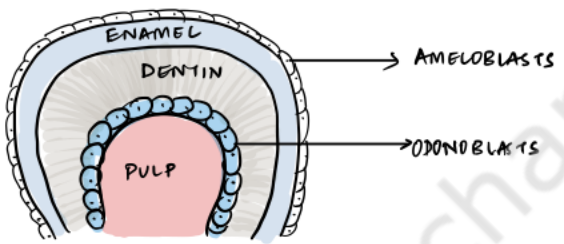
NON-ODONTOGENIC

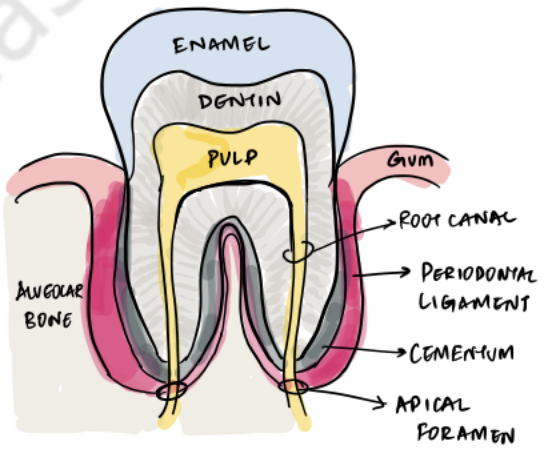
BENIGN
1) Osteoma
2) Osteoclastoma
2) Fibroma

MALIGNANT
1) SCC
2) Osteosarcoma
3) Ewing Sarcoma
4) Chondrosarcoma
5) Multiple Myeloma
6) Lymphoma/Leukemia
7) Metastasis

ODONTOGENIC TISSUE

1) Odontoblasts - cells of dentin ? neural-crest mesenchymal origin that produce
2) Ameloblasts - cells of ectodermal origin that produce enamel
3) Cementoblasts - cells of mesenchymal origin that produce cementum





WHO Classification of Odontogenic tumors (2017)

Epithelial tumors
1) Ameloblastoma
2) Squamous odontogenic tumor
3) Calcifying epithelial odontogenic tumor (PINDBORG TUMOR)
4) Adenomatoid odontogenic tumor
5) Keratinizing cystic odontogenic tumor

Epithelial + Ectomesenchyme (MIXED)
Ameloblastic fibroma
Ameloblastic fibro-odontoma
Ameloblastic fibro-dentinoma
Complex / Compound odontoma

Ectomesenchyme ± Odontogenic epithelium
Odontogenic fibroma
Odontogenic myxoma
Cementoblastoma

AMELOBLASTOMA (previously called ADAMANTINOMA OF JAW)

Ameloblastoma - odontogenic tumor → from remnants of odontogenic epithelium → RESTS OF DENTAL LAMINA

↓

Locations : soft tissues of Gingiva / Alveolar mucosa

Lining of odontogenic cysts

- m/c odontogenic tumor
- middle age 20-40y , M=F , Asians
- Can occur in all areas of jaws - BUT
  → 80% → mandible
  ↘ molar angle ramus area
- MAJORITY — BENIGN, but locally aggressive
  very rarely - ameloblastic carcinoma
  ↳ LN, Distant spread

TYPES
- Classic / Solid / Multicystic ameloblastoma
- Unicystic ameloblastoma
- Peripheral ameloblastoma
- Desmoplastic ameloblastoma

Clinical presentation

- Slow-growing → swelling → facial asymmetry
  - Reactive new bone formation → jaw enlargement & distortion
  - Initially, hard swelling → Thinning of cortical bone → 'Egg shell crackling'
    - long standing → Tumor perforation & soft tissue spread → Ulceration
- Tooth mobility (displacement of teeth resorption of roots)
- Inferior alveolar canal involvement - Paraesthesia
- Maxillary ameloblastomas → can grow upwards to involve sinonasal passages, pterygomandibular fossa, orbit, cranium

RADIOLOGY

Radiolucent area ± expansion of overlying cortical bone → 'SOAP BUBBLE' / 'Honeycomb appearance'
Scalloped margins / Multilocular appearance
Resorption of roots of adjacent teeth

Rx - TOC - Surgery - Curettage is not sufficient

Mandible - Segmental mandibulectomy ; Maxilla - Partial maxillectomy

RT may improve long term locoregional control

EPULIS - non-specific term used for swellings over the gums
(gingival / alveolar mucosa)

1) Congenital Epulis / Neumann tumor - MYOBLASTOMA in gums of newborns - canine area
   Not malignant
   Rx - Excision
2) Fibrous Epulis → Fibroma of periodontal membrane
   → m/c epulis
3) Granulomatous Epulis - granulation tissue around caries tooth
4) Pregnancy Epulis - inflammatory gingivitis of pregnancy
   - usually resolves after delivery
5) Carcinomatous Epulis - SCC of alveolus / gum
6) Myelomatous Epulis - seen in leukemic pts
7) Fibrosarcomatous Epulis - fibrosarcoma of gum
8) Giant cell Epulis - Osteoclastoma causing ulceration / hemorrhage of gum
9) Epulis fissuratum - Benign hyperplasia of fibrous tissue of gum
   d/t ill-fitting dentures

ODONTOGENIC CYSTS

Epithelial-lined swellings derived from odontogenic epithelium

PERIAPICAL/RADICULAR CYST → m/c

cyst arising at the apex/ root of infected erupted tooth

INFECTED TOOTH
↓
Pulp necrosis
↓
necrotic matter exits at root/ apex of tooth
↓
Periapical inflammation
↓
Stimulation of Malassez epithelial rests in the periodontal ligament
↓
PERIAPICAL GRANULOMA
↓ necrosis
CYST
↓
Osteomyelitis

℞ - Endodontic ℞ of involved tooth

- Cyst excision + HPE
(SCC may arise in long standing cyst very rarely)

DENTIGEROUS CYST / FOLLICULAR CYST

cyst developing within the NORMAL dental follicle surrounding an UNERUPTED TOOTH

most frequently found in areas where unerupted teeth are found

- Mandibular & Maxillary 3rd molars
- Maxillary canines

Size - can grow quite large

HPE:
Reduced Enamel epithelium of the dental follicle is replaced by STRATIFIED SQUAMOUS NON-KERATINISING EPITHELIUM & dystrophic calcification & clusters of mucous cells

Epithelium lining the dentigerous cyst can lead to

- AMELOBLASTOMA (17% ameloblastoma arise in dentigerous cysts)
- Mucoepidermoid carcinoma (from mucous cells)
- squamous cell carcinoma

℞ - Excision + HPE

RESIDUAL CYST

↓
Retained periapical cysts of the teeth which have been removed.

PRIMORDIAL CYST

↓
Arises when dental follicle undergoes cystic degeneration even before completing odontogenesis

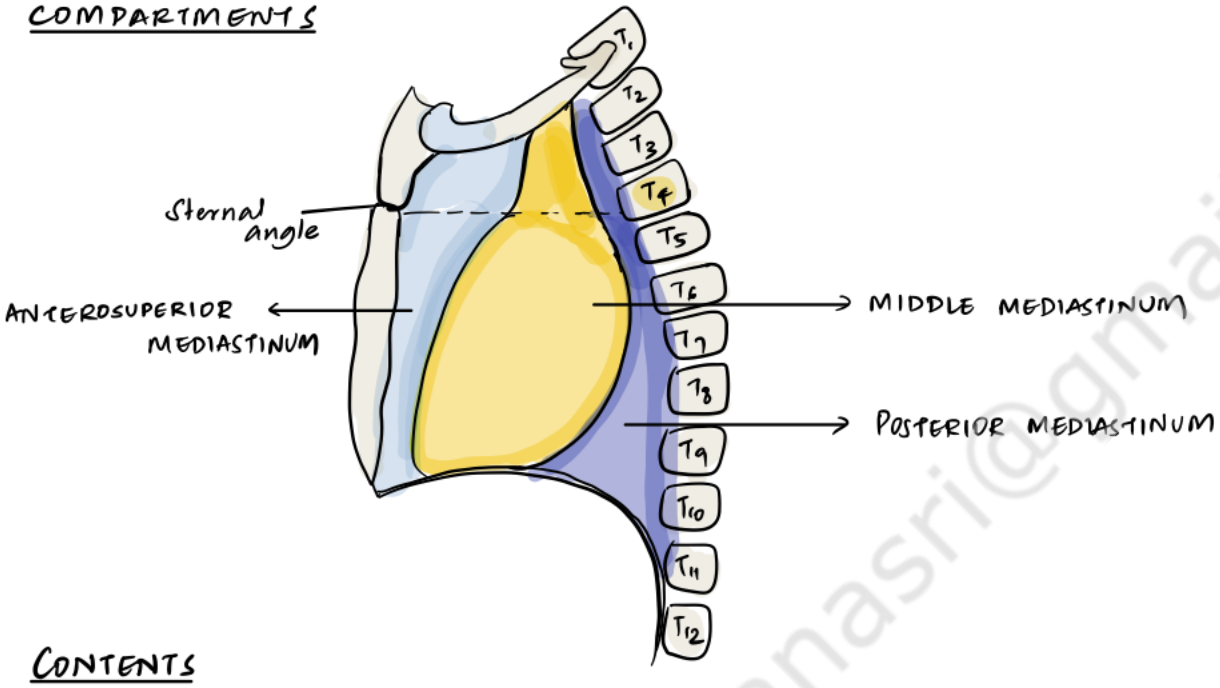
i.e.; cyst develops instead of tooth
- very rare

MEDIASTINUM

ANATOMY

- Central area in the chest
  - between the thoracic inlet and the diaphragm
  - between the (R) and (L) pleural surfaces
  - between inner aspect of the sternum to the vertebral column

COMPARTMENTS



CONTENTS

ANTEROSUPERIOR MEDIASTINUM

- Thymus / its remnants
- Internal mammary vessels
- Lymphnodes
- Fat

MIDDLE MEDIASTINUM (Visceral compartment)

- Pericardium & its contents
- ascending aorta, arch of aorta
- superior & inferior vena cavae
- Pulmonary vessels - central portion
- Phrenic N Vagus
- Trachea & main bronchi
- Esophagus
- Thoracic duct
- Lymphnodes

POSTERIOR MEDIASTINUM (Paravertebral sulcus)

- Descending aorta
- Azygous & hemiazygous veins
- Lymphnodes
- Sympathetic chain
- Segmental nerves

MEDIASTINAL MASSES

ANTEROSUPERIOR MEDIASTINUM

- THYMOMA
- THYMIC CYST
- RETROSTERNAL GOITER
- PARATHYROID ADENOMA
- GERM CELL TUMOR
- LYMPHOMA
- Lymphangioma Hemangioma
- Fibroma / Lipoma

MIDDLE MEDIASTINUM

- PLEUROPERICARDIAL CYST
- FOREGUT CYSTS
- PARAGANGLIOMA
- MESENCHYMAL TUMORS
- THORACIC DUCT CYST
- LYMPHOMA
- MEDIASTINAL GRANULOMA
- LYMPHOID HAMARTOMA

POSTERIOR MEDIASTINUM

- NEURILEMMOMA
- SCHWANNOMA
- GANGLIONEUROMA
- NEUROBLASTOMA
- PARAGANGLIOMA

LYMPHOMA
FIBROSARCOMA

Clinical Features

- Only ~1/3rd – symptomatic
- Symptoms depend on
  - size
  - nature
  - location
- SVC syndrome
- RLN palsy
- Horner's Syndrome
- Pancoast Syndrome

Evaluation

- CXR – Mediastinal widening
- CT – for anterior & middle mediastinum
- MRI – for posterior mediastinum
- Thymoma – FDG-PET
- Diaphragm fluroscopy / 'Sniff' test for Dx of phrenic nerve palsy
- Germ cell tumors – tumor markers

Mediastinal Syndrome

Clinical features arising due to compression of mediastinal structures by a mass

Trachea & main bronchi – Dyspnea
Cough
Stridor
Flslo lung collapse

Esophagus – dysphagia

SVC – SVC syndrome

(L) RLN – voice change, bovine cough
Phrenic nerve – diaphragmatic palsy
Sympathetic trunk – Horner's Syndrome

MEDIASTINITIS

ACUTE MEDIASTINITIS

Fulminant infectious process

Causes

1) ESOPHAGEAL DISRUPTION → m/c
   - Iatrogenic - Dilatation / Scopy / Sclerotherapy
   - Spontaneous - Boerhaave
   - Trauma / Corrosive ingestion
   - Post Surgical - infection, anastomotic leak
   - Malignancy - erosion
2) DEEP STERNOTOMY WOUND INFECTION
3) OROPHARYNGEAL & NECK INFECTIONS
   - Cellulitis, suppurative LN
4) LUDWIG's ANGINA
5) QUINSY
6) RETROPHARYNGEAL ABSCESS
7) LUNG & PLEURAL INFECTIONS
8) SUBPHRENIC ABSCESS
9) RIB / VERTEBRAL OSTEOMYELITIS
10) HEMATOGENOUS / METASTATIC ABSCESS

can spread rapidly along continuous fascial planes connecting cervical and mediastinal compartments

Clinical features
- Fever
- Chest pain
- Respiratory distress
- Dysphagia
- Cervical, Upper thoracic s/c crepitus
- SEPSIS

CT - extent
- helps select route of surgical drainage

Rx - Resuscitate, Systemic Abx
Drain collections / debride
Rx primary problem

CHRONIC MEDIASTINITIS

sclerosing / fibrosing mediastinitis

originates in mediastinal lymph nodes

Causes:
? Granulomatous infections
- HISTOPLASMOSIS
- TUBERCULOSIS

Similar to retroperitoneal fibrosis / Sclerosing cholangitis / Riedel thyroiditis

↓ Chronic, low grade inflammation

FIBROSIS
SCARRING

- Entrapment / Compression of great veins
- Esophageal involvement

No definitive Rx

Surgery is aimed at
- relieve of airway or esophageal obstruction
- vascular reconstruction

MEDIASTINAL CYSTS

Primary cysts of mediastinum - 20% of mediastinal masses - Benign

TYPES

BRONCHOGENIC

m/c primary cyst of mediastinum

↓

originate as sequestrations from the ventral foregut (antecedents of the tracheobronchial tree)

↓

can be located
- within lung parenchyma (15%)
- in the mediastinum (85%)

± communication ĩ bronchial tree

Imaging - air-fluid level in mediastinum

Splaying of carina

Resection recommended if >6cm or symptomatic

PERICARDIAL

2nd m/c

occur in the cardiophrenic angle

(R) (70%) > (L)

± communication ĩ pericardium

clear fluid

Rx -
Needle aspiration
Routine surveillance

ENTERIC

syn. duplication cysts

arise from primitive foregut

usually attached to esophagus

Esophageal compression

↓

Dysphagia

can cause - hemorrhage, infection, perforation

Neuroenteric cysts
- a/ĩ anomalies of vertebral column

↓

Excision recommended

THYMIC

rare
- 1-3% of mediastinal masses

Congenital/ Acquired

↓ ↓

- contain thymic tissue in wall
- unilocular

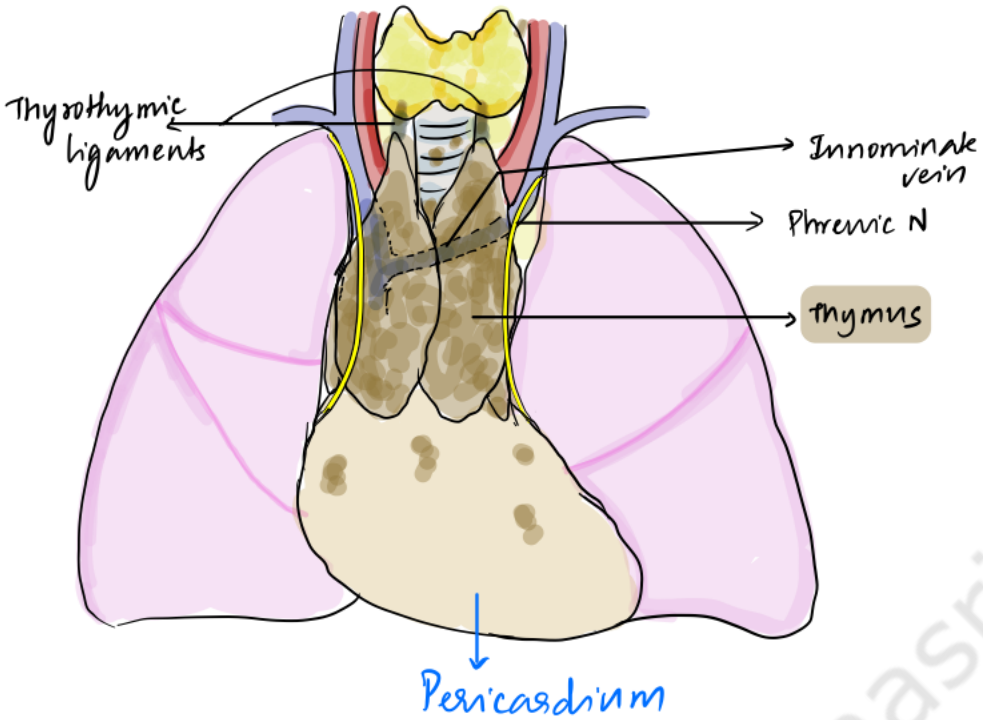
- 20 to CTRT
- After thoracotomy

Large cysts a/ĩ HIV

Malignancy should be ruled out

THYMOMA

ANATOMY OF THYMUS - located in anterior superior mediastinum
- Bilobed
- covers the great vessels and pericardium



Blood supply
- internal thoracic A
- inferior thyroid A
- pericardiophrenic V

LACKS AFFERENT LYMPH CHANNELS

efferent lymph channels (+)
↓
drain thymic capsule & septae to anterior mediastinal, pulmonary hilar & internal mammary nodes

CELLS - arranged in cortex & medulla
- Lymphoid cells → T lymphocytes +++++
  occasional B cells & germinal centres
- Epithelial cells

MYOID CELLS - express AChRs - may be involved in pathophysiology of MG

THYMOMAS

- m/c primary neoplasm of the anterior mediastinum in adults (2nd m/c - lymphoma)
- 40-60y
- rare in children

All thymomas arise from thymic epithelium - but contain mixed populations of cells
- lymphocytes
- Epithelial cells
- Spindle cells

May be benign / invasive

Thymic carcinoma - separate entity

CLINICAL FEATURES

DUE TO COMPRESSION / INVASION BY LESION

1) Chest pain
2) Dyspnea
3) Cough
4) Hemoptysis
5) Superior vena cava Syndrome

external compression of SVC
- facial swelling and congestion
- Upper extremity edema
- Shortness of breath
- distension of neck veins
  → exacerbated by bending forward / lying down
- cough

NON SPECIFIC SYMPTOMS

- Anorexia
- Fatigue

DUE TO IMMUNOLOGIC DISORDERS

MYAESTHENIA GRAVIS

- m/c syndromic presentation of thymoma
- 30-60 % thymoma - MG
- Thymectomy resolves MG in 25 % of thymoma pts
- Thymectomy resolves MG in 50 % of pts WITHOUT THYMOMA

75 % MG patients have thymic abnormalities
→ Majority-thymic hyperplasia

- pathology - circulating antibodies to Ach-R
  - Skeletal muscle weakness
  F : M 3 : 2

Other systemic Syndromes a/i
THYMOMA
Pure red cell aplasia / Aplastic anemia
HYPO / HYPERGAMMAGLOBULINEMIA
Dermatomyositis
SLE, Systemic Sclerosis
Hypercoagulable state
Granulomatous myocarditis

MASAOKA THYMOMA STAGING SYSTEM

Stage I : Encapsulated tumor ± no macro / microscopic capsular invasion

Stage II : Microscopic / Gross capsular invasion / Invasion into mediastinal fat, pleura

Stage III : Gross invasion of pericardium / great vessels / lung

Stage IV
- IV A - Pleural / Pericardial dissemination
- IV B - Lymphogenous / hematogenous metastasis

EVALUATION

CXR - Mediastinal widening

CT - Anatomic location
Size & Extent
Density
Pulmonary / Pleural mets
Mediastinal nodes

Pre-operative tissue biopsy - usually unnecessary
Transpleural approach contraindicated 2/t risk of seeding pleural space
Percutaneous image guided core biopsy only if { LYMPHOMA is suspected
unresectable thymic neoplasms needing definitive CT/RT

MG workup - anti-AChR antibodies

MANAGEMENT

Stage I - Thymectomy alone

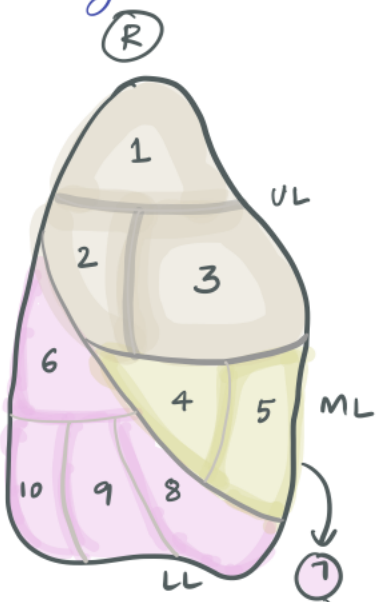
Stage II & III - Adjuvant RT

Tumors > 5cm, locally invasive, unresectable / metastatic
↓
chemo
↓
Radical ← Surgery
↓
RT

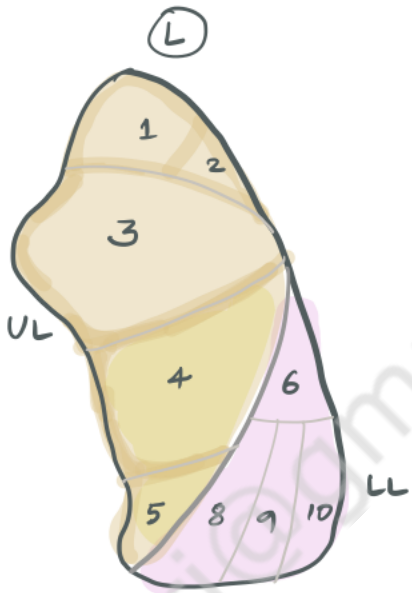
Thymectomy
↳ Trans-sternal approach
VATS
Robotic
Transcervical

BRONCHOPULMONARY SEGMENTS

A bronchopulmonary segment is a portion of the lung supplied by a specific segmental bronchus and a specific branch of the pulmonary artery

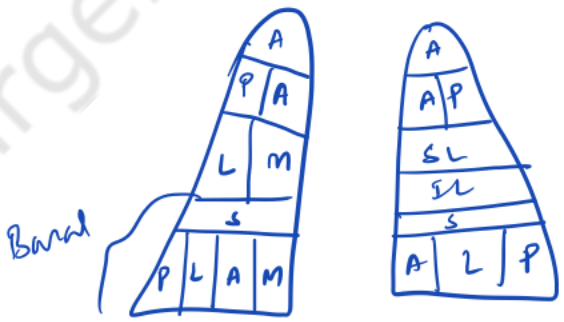


1) Apical
2) Posterior
3) Anterior
4) Lateral
5) Medial
6) Superior Basal
7) Medial Basal
8) Anterior Basal
9) Lateral Basal
10) Posterior basal



1) Apical
2) Posterior
3) Anterior
4) Superior lingular
5) Inferior lingular
6) Superior Basal
7) X
8) Anterior Basal
9) Lateral Basal
10) Posterior basal

Segmental anatomy → Segmental resections



LYMPHATIC DRAINAGE OF LUNG

PULMONARY LYMPHNODES (N_1)

1) Intrapulmonary / Segmental nodes
   - lie in the
     - points of division of segmental bronchi
     - bifurcations of pulmonary artery

2) Lobar nodes
   - lie along UPPER, MIDDLE, LOWER lobe bronchi

3) Interlobar nodes
   - at the points where main bronchi bifurcate into lobar bronchi
   - lie in interlobar fissure
   - constitute lymphatic Sump of Borrie

4) Hilar nodes
   - along main bronchi

MEDIASTINAL LYMPHNODES (N_2)

1) Anterior mediastinal nodes
   along -
   - upper surface of pericardium
   - Phrenic nerves
   - Ligamentum arteriosum
   - (L) aspect of innominate vein

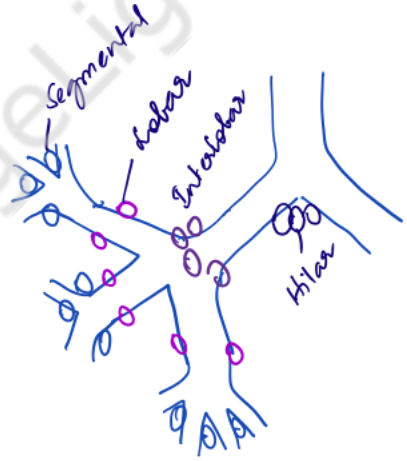
2) Posterior mediastinal nodes
   - nodes within inferior pulmonary ligament
   - Nodes between trachea & esophagus near arch of azygous vein

3) Tracheobronchial nodes
   - SUBCARINAL NODES

4) Paratracheal nodes
   ↓
   located in superior mediastinum close to trachea

(R) lung → ipsilateral mediastinal nodes

(L) lung- esp lower lobe → early contralateral mediastinal nodes



LUNG CANCER

m/c cause of cancer death in both men & women
m/c visceral malignancy

Etiology

1) Smoking
   - 85-90% cases of lung cancer
   - Smokers - 30x risk
   - Passive smoking increases risk 2 fold

Risk is related to cumulative dose of tobacco carcinogens - 'pack years'
Incidence of lung cancer death begins to diverge from non-smoking population at 10 pack years

After smoking cessation - risk steadily declines
↓
approaches that of non smokers after 15 years of cessation in people who have smoked < 20y

'FIELD CANCERIZATION' hypothesis
- upper aerodigestive cancers
- synchronous & metachronous lung cancers

SCC } - almost always associated c̄ smoking
SCLC }

Lung cancer develops in 15% of heavy smokers
Giant bullous emphysema & airway obstructive disease can act synergistically with smoking to induce lung cancer
Higher lung cancer mortality in smokers

2) Asbestos - malignant mesothelioma
   Lung Ca (Smoking + Asbestos — 3x risk compared to smoking alone)

3) Radiation exposure - ↑ SCLC risk in smokers + non smokers
   Radon exposure

4) Toxins: Arsenic, Nickel, chromium compounds, chloromethyl ether, air pollutants, mining of radioactive ores

5) Mutations

EGFR mutations } NSCLC in never/minimal smokers
ALK mutations }

CLASSIFICATION

TYPES

SMALL CELL LUNG CANCER
↓
15% of all lung cancers

ARISE FROM NEUROENDOCRINE CELLS - 'KULCHITSKY' CELLS

Location: Central / hilar (95%) > Peripheral (5%)

Often have widespread disease at the time of diagnosis
- Mets to Brain, Bone marrow, liver
- Pleural effusions ⊕
- Recurrence - Local + Remote

PARANEOPLASTIC SYNDROMES

SIADH (m/c)
Hypercoagulable state - common
ectopic ACTH - uncommon
Lambert-Eaton Myasthenic Syndrome - rare

Hypercalcemia - very rare in SCLC even in presence of extensive bony mets

NON SMALL CELL LUNG CANCER
↓
85% of all lung cancers

	ADENOCARCINOMA (50-60% NSCLC)	SCC (20-25% NSCLC)	LCLC
Location:	Peripheral	Central, CAVITATING	anywhere
	Localised nodule in >50% cases ↓ Blood spread Bones, Liver Brain	localized during early disease ↓ Recur locally after Sx / RT	Aggressive behaviour & early metastasis to mediastinal nodes & distant sites
PARANEOPLASTIC SYNDROMES	• Hypertrophic osteoarthropathy • Hypercoagulable state • Hypercalcemia (PTH-RP / cytokines)	• Hypercalcemia d/t ectopic PTH-RP (m/c) • Hypertrophic osteo-arthropathy (occasional) • Paraneoplastic neutrophilia - Hypercoagulability	Ectopic hormone production and paraneoplastic syndromes are TYPICALLY ABSENT NOT TO BE CONFUSED & LARGE CELL NEUROENDOCRINE VARIANT

NEUROENDOCRINE CARCINOMA - NEC - ⊕ IHC for chromogranins, synaptophysin CD 57, Neuron specific enolase

(from Kulchitsky cells)

GRADE-1 NEC	GRADE-2 NEC	GRADE-3 NEC	GRADE-4 NEC
CLASSICAL / TYPICAL CARCINOID	ATYPICAL CARCINOID	LARGE-CELL TYPE TUMORS	↓ SCLC
80% - central airway epithelium younger patients (CENTRAL LESION) ↘ vascular	more peripherally located - necrosis - pleomorphisms	mid to peripherally located ↑ in heavy smokers	↓ Central lesion ↓ Early widespread mets
Regional nodes ~15%	Nodes - 30-50%	similar to LCLC but	Pure SCLC / SC+ LC / Combined or mixed
↓ Systemic spread	25% Distant mets	true IHC for atleast 1 neuroendocrine marker	

CLINICAL FEATURES

PRIMARY LUNG CANCER ASSOCIATED

PULMONARY

d/t direct effect of tumor on bronchus / lung tissue

1) COUGH - d/t Bronchus irritation or compression
2) DYSPNEA - d/t central airway obstruction or compression
3) WHEEZE - d/t > 50% airway obstruction
4) PNEUMONIA - d/t Airway obstruction c̄ subsequent infection
5) HEMOPTYSIS - d/t tumor erosion into capillaries
6) LUNG ABSCESS - d/t tumor necrosis & cavitation c̄ superadded infection

NON-PULMONARY THORACIC

d/t invasion of the primary tumor directly into a contiguous structure or from mechanical compression of an adjacent structure

1) CHEST PAIN – Peripherally located tumors
   - breach ↓ visceral pleura ↓ Parietal pleura ↓ chest wall structures
   - Pleuritic pain
   - Chest wall pain - rib & intercostal muscle
   - Radicular pain - intercostal nerve
2) PANCOAST SYNDROME - tumors arising in the superior sulcus / posterior apex
3) PHRENIC NERVE PALSY - tumors at the medial lung surface / anterior hilum - invade the nerve as it courses the thorax
4) RLN PALSY (LEFT) - Ⓛ hilar tumor / lymph node
5) SVC syndrome - d/t
   - bulky mediastinal nodes
   - medial Ⓡ UL tumor

   m/c c̄ SCLC
6) PERICARDIAL & PLEURAL EFFUSION
7) BACK PAIN - vertebral body & neural foramina
8) DYSPHAGIA - esophageal compression

PARANEOPLASTIC

1) ENDOCRINE
   - Hypercalcemia (PTH-rP)
   - Cushing's (ACTH)
   - SIADH
   - Carcinoid syndrome
   - Gynecomastia (PRL, FSH, LH)
   - Hypercalcitoninemia
   - Hypoglycemia
   - Hyperthyroidism
2) NEUROLOGIC
   - Encephalopathy
   - Subacute cerebellar degeneration
   - PMLE
   - Peripheral neuropathy
   - Polymyositis
   - LEMS
   - Optic neuritis
3) SKELETAL
   - Clubbing - HPOA
4) HEMATOLOGICAL
   - Leukemoid reaction
   - Anemia / Red cell Aplasia
   - DIC / Hypercoagulable state
5) Cutaneous
   - Hyperkeratosis
   - Acanthosis nigricans
   - Dermatomyositis
   - Erythema gyratum repens
   - Hypertrichosis lanuginosa acquisita
6) OTHER
   - Nephrotic Syndrome
   - Hypouricemia
   - Hyperamylasemia
   - Anorexia
   - Cachexia

METASTATIC

Commonly metastasizes to
- CNS
- Vertebral bodies
- Bone
- Liver
- Adrenals
- Lung
- Skin
- Soft tissues

CNS mets - 10% at Dx
- headache
- nausea
- seizures
- FND

Spinal cord compression
- vertebral mets
- invasion of intervertebral foramen

Bony metastasis - lytic

Adrenal - adrenal hypofunction

EVALUATION

- Chest x Ray
- CT chest & abdomen (upto adrenal glands)

] For primary

Pathological diagnosis

1) Sputum Cytology - +ve in 60-80% centrally located
   20% peripherally located
2) Flexible fiberoptic bronchoscopy ± Endoscopic bronchial ultrasound
3) Percutaneous / transbronchial needle biopsy
4) Other biopsies - peripheral LNs
   suspicious cutaneous nodules

Metastatic / Staging Workup

1) PET-CT - for distant occult mets
   - restaging after neoadjuvant Rx
   - follow-up
2) Spinal MRI - Lung Ca + back pain
3) Brain CT / MRI - Routinely in SCLC
   Advanced NSCLC
4) **Mediastinoscopy**

   Routine pre-operative staging for NSCLC (Radiologic assessment inadequate)
5) Bone scan

Fitness Workup

- Cardiac status - ECG, Echo
- Pulmonary status - PFT
  Excercise testing
  Quantitative perfusion lung scan

STAGING - AJCC 8- TNM

T

Tx - cannot be assessed
(No imaging / bronchoscopic e/o 1° in ⊕ of malignant cells in sputum / bronchial washings)

T0 - no e/o primary

Tis
- SCC in situ
- Adenocarcinoma in situ: pure lepidic pattern ≤ 3cm

T1 (< 3cm)
- T1mic - minimally invasive adenocarcinoma (≤ 5mm invasion) ≤ 3cm
- T1a - ≤ 1cm
- T1b - 1-2cm
- T1c - 2-3cm

(T1a / T1b / T1c)
- surrounded by lung / visceral pleura
- no bronchoscopic e/o invasion beyond lobar bronchus

T2 (3-5m)
- T2a - 3-4cm
- T2b - 4-5cm

(T2a / T2b)
- Involves main bronchus but spares carina
- Invades visceral pleura
- a/i atelectasis / obstructive pneumonitis

T3 - 5-7cm / directly invading - parietal pleura
chest wall
phrenic nerve
parietal pericardium
/ separate tumor nodules in same lobe as primary

T4 - > 7cm / any size - invading - diaphragm
mediastinum
heart & great vessels
trachea / carina
RLN
Esophagus
vertebral body
/ separate tumor nodules in lobe different from primary in same lung

N

- Nx - cannot be assed
- N0 - no regional LNs
- N1 - ipsilateral peribronchial / hilar / intrapulmonary
- N2 - ipsilateral mediastinal / subcarinal
- N3 - contralateral hilar / mediastinal / any scalene / supraclavicular

M

- M0 - no distant mets
- M1a - contralateral lung
  pleural / pericardial nodules
  Malignant pleural / pericardial effusion
- M1b - single extrathoracic mets
- M1c - Multiple extrathoracic mets

GRADING

G_x - cannot be assessed

G_1 - well differentiated

G_2 - Moderately differentiated

G_3 - Poorly differentiated

G_4 - undifferentiated

STAGE GROUPING

Occult Carcinoma - T_x N_0 M_0

Stage 0 - T_{is} N_0 M_0

Stage I
- IA_1 - T_{1mic} N_0 M_0; T_{1a} N_0 M_0
- IA_2 - T_{1b} N_0 M_0
- IA_3 - T_{1c} N_0 M_0
- IB - T_{2a} N_0 M_0

Stage II
- IIA T_{2b} N_0 M_0
- IIB T_{2a} N_1 M_0; T_3 N_0 M_0

Stage III
- IIIA - T_{2b} N_2 M_0, T_3 N_1 M_0, T_4 N_0 M_0
- IIIB - T_{2b} N_3 M_0, T_3 N_2 M_0, T_4 N_1 M_0
- IIIC - T_3 N_3 M_0, T_4 N_3 M_0

Stage IV
- IVA - Any T Any N M_{1a}/M_{1b}
- IVB Any T Any N M_{1c}

MANAGEMENT

NON-SMALL CELL LUNG CANCER

Stage I, II — upto 7 cm, No, N1, limited invasion

Operable

↓ Sx is TOC (Open / VATS / Robotic)

→ **SUBLOBAR RESECTIONS**
- Non anatomic Wedge resections
- Segmentectomies
  ↓
  in elderly / frail pts
  (- risk of local failure vs physiological impact)

→ **LOBECTOMY** - procedure of choice when feasible

→ **BILOBECTOMY**

→ **SLEEVE LOBECTOMY**

→ **PNEUMONECTOMY**

Inoperable (Resectable but inoperable)

↓ d/t poor general condition of patient

↓

- STEREOTACTIC BODY RADIOTHERAPY
  OR
- DEFINITIVE STANDARD FRACTIONATED RT
  OR
- CHEMORADIATION (especially in N_1 disease)
  ↓
  do poorly c RT alone

I Lymphnode dissection → Complete Mediastinal LN dissection improves overall staging
→ No proven survival benefit

→ Pancoast tumor ($T_3N_0M_0$-IIB)
- pre-op RT / CTRT

Extended resections- carinal resection, sleeve resection
Hemivertebrectomy + spine instrumentation for pancoast tumor

Adjuvant CT

- Platinum based
- Stage IIa, IIb
- Stage Ib >4cm

Targeted agents

Adjuvant RT

No added survival benefit in node negative or N_1
$\geq N_2$ ✓

Inoperable disease

Locally advanced (Stage III)

- Malignant Pleural effusion
- Superior Vena cava obstruction
- Supraclavicular / Cervical nodes (HPE proven)
- RLN involvement
- Tracheal wall involvement / mainstem bronchus <2cm from carina

↓

concurrent / sequential chemoradiotherapy

or

chemotherapy / chemoradiotherapy ffb surgery

Stage IV → PS poor supportive

SQUAMOUS

NON SQUAMOUS

No driver mutations

PDL-1

- <50% → Platinum based chemo
- >50% → Pembrolizumab

Driver mutations → ↓

Targetted Rx

EGFR - Gefitinib / Erlotinib
ALK - Crizotinib / Alectinib
BRAF - Vemurafenib / Dabrafenib

SMALL CELL LUNG CANCER

poor prognosis

LIMITED STAGE (<5%)

Combined modality Rx

- Concurrent CT + Thoracic RT
  - ↓ Cisplatin + Etoposide
- Prophylactic Cranial irradiation

Infrequent but beneficial role of surgery in single peripheral pulmonary nodule ± negative mediastinoscopy ± good performance status

EXTENSIVE

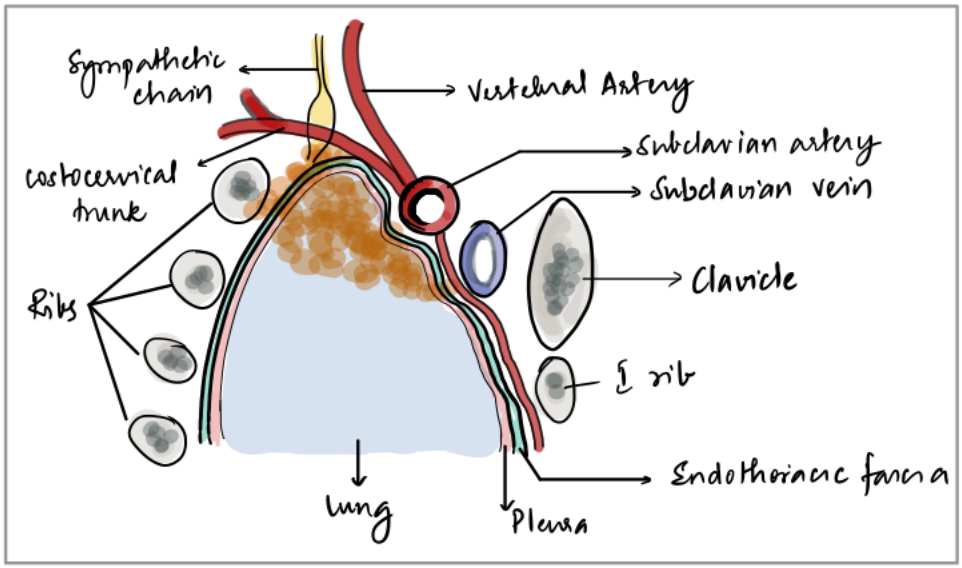
↓

chemo

- Cisplatin + Etoposide
- Cyclophosphamide
  Doxorubicin
  Vincristine

PANCOAST TUMOR

Pancoast tumors - pulmonary neoplasms present in the "SUPERIOR SULCUS" (APICAL PLEUROPULMONARY GROOVE)



arise from the posterior apical segment of the upper lobes

- extend into thoracic inlet

- m/c - NSCLC (95%)

term should be reserved for tumors invading parietal pleura & beyond - ABOVE THE LEVEL OF I RIB

Due to extreme peripheral location of the tumor, it spreads to the chest wall structures rather than to the lung parenchyma

↓

Early local invasion

Clinical features

1) Apical chest wall / shoulder pain - involvement of Parietal Pleura, intercostal Ns, I rib and chest wall
2) Horner's Syndrome - d/t invasion of stellate sympathetic ganglion
   - Unilateral enophthalmos
   - ptosis
   - miosis
   - facial anhidrosis
3) Radicular upper limb pain - d/t invasion of T_1, occasionally C_8 brachial plexus nerve roots
   Atrophy of hand muscles
4) Edema - involvement of blood vessels & lymphatics

SVC, RLN, Vagus and phrenic nerve may be involved but do not represent classic Pancoast tumor

Extension into neck / vertebrae → bad prognosis

EVALUATION

- Apex of lung - difficult to image because it is bounded laterally and posteriorly by first rib ; posteriorly by vertebrae

Plain x-rays may not show any change

may see bony destruction in ribs / vertebrae / apical cap
mediastinal widening in case of nodal spread

- CT / MRI ✓
  - ↳ aid staging
  - ↳ deciding operability

Bone involvement
invasion of brachial plexus, chest wall, vena cava, trachea, esophagus, subclavian vessels
Mediastinal adenopathy

- Sputum cytology, Bronchoscopy } unreliable - ∵ tumor is peripherally located
  - FNAC ✓

Stage can be II b to III C

II b	T_3 N_0	→ amenable to surgery
II A	T_3 N_1	→ nodal involvement → poor prognosis
II B	T_3 N_2	
III C	T_3 N_3	

MANAGEMENT

Metastatic / ≥ N_2 disease - DEFINITIVE CHEMORADIATION

Operable → Poor PS → DEFINITIVE CHEMORADIATION

Operable → Concurrent Induction chemo (Cisplatin + Etoposide) + RT - 45 Gy × 5 weeks

↓

Surgery - Thoracotomy
en-bloc chest wall resection
Lobectomy
chest wall reconstruction

SOLITARY PULMONARY NODULE

single, well circumscribed spherical lesion ≤3cm completely surrounded by normal aerated lung parenchyma

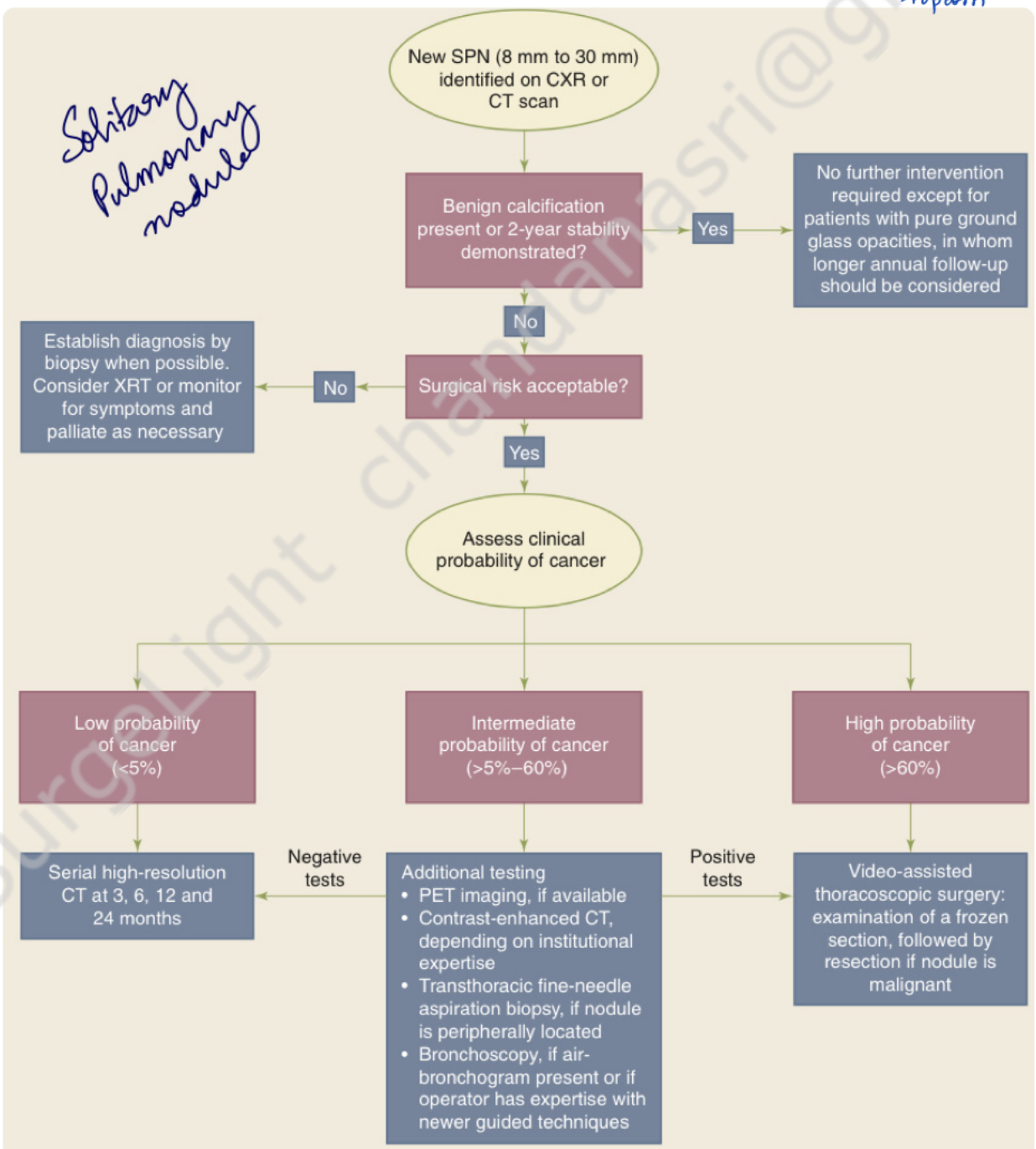
↓

[No lung atelectasis / hilar enlargement / pleural effusion]

Significance - to determine the likelihood of the nodule being malignant

SPN on x-ray - should be characterised by CT

- nodule
  - number
  - location
  - size (>3cm → malignant)
  - margin
    - Malignant ← corona radiata sign ← irregular / lobulated / spiculated – Malig
  - morphology
  - calcification
    - pattern
      - Diffuse
      - Solid
      - central
      - Laminated → Popcorn
      - Benign
      - stippled
      - amorphous
      - eccentric
      - malignant
  - growth rate



SURGERY IN PULMONARY TUBERCULOSIS

INDICATIONS

- SURGICAL THERAPY may be considered when medical therapy fails
- persistent TB +ve sputum remains + surgically correctable residua

↓

1) Open positive cavity despite 3-6m ATT especially in MDR-TB
2) Destroyed lung, atelectasis, bronchiectasis, bronchostenosis amenable to resection
3) Open negative cavities if thick-walled, slow response, unreliable patient
4) Intracavitary aspergillosis
5) To obtain tissue for definitive diagnosis - exclusion of cancer
6) Complications of pulmonary scarring
   - Massive hemoptysis
   - Cavernomas
7) Pleural tuberculosis
8) Extrapulmonary thoracic involvement

The governing principle of mycobacterial surgery is to remove all gross disease while preserving any uninvolved lung tissue

Antitubercular medications should be given pre-operatively x 3m & post-operatively for 12-24m

PROCEDURES

1) EXCISION OF DISEASED LUNG TISSUE
2) DRAINAGE OF PUS < CATHETER DRAINAGE / CAVERNOSTOMY / OPEN DRAINAGE
3) COLLAPSE THERAPY

Historical - preantibiotic era - mainstream of treating CAVITARY TB

Artificial pneumothorax & its refills
Phrenic nerve crush
Thoracoplasty
Extrapleural plombage

EMPYEMA THORACIS

Empyema - infection of the pleural space - 'purulent pleural effusion'

PATHOGENESIS

CONTAMINATION FROM A SOURCE CONTIGUOUS TO THE PLEURAL SPACE (50-60%)

- Lung (Parapneumonic effusion)
- Mediastinum (Mediastinitis)
- Deep cervical area (infection)
- Chest wall & spine
- Subphrenic area (abscess)

DIRECT INOCULATION OF THE PLEURAL SPACE (30-40%)

- Minor thoracic interventions
- Post-operative infections (Bronchopleural fistula after lobectomy / pneumonectomy)
- Penetrating chest injuries

HEMATOGENOUS INFECTION (<1%)

- Systemic sepsis

Organisms enter the pleural space
↓
Influx of polymorphonuclear cells, exudative fluid } d/t inflammatory response
↓
overwhelms pleural lymphatics
↓
INFECTIVE FLUID IN PLEURAL SPACE

→ Initially - free flowing and thin

THORACOCENTESIS
- pH > 7.3
- Glucose > 60mg/dL
- LDH (↓) - < 500U/L

↓

Antibiotics

- Clinical Response, Complete lung expansion ✓
- Persistent
  - pH < 7.2, Glucose < 40mg/dL
  - ↓ ℞ COMPLETE DRAINAGE during early stage (Thoracocentesis)

Delay - hrs to days → **FIBRINOPURULENT STAGE**

℞ ē intrapleural fibrinolytic (t-PA / DNAse)

℞ - Tube thoracostomy ē closed system drainage
- Drainage ē thoracoscopy

Delay ↓

Pleural Peel
- initially flimsy - easy to peel
- thick pleural rind → trapped lung → needs complete decortication by thoracoscopy / thoracotomy to enable re-expansion

Failure / high risk →

℞ - Open drainage, rib resection, prolonged packing
- delayed closure ē muscle flaps / thoracoplasty
- Rarely Pleuropneumonectomy

COMPLICATIONS

Empyema thoracis necessitans

↓

Extension of pleural empyema out of thorax

↓ into

Subcutaneous tissues of chest wall (m/c)

LUNG ABSCESS

- Localised area of pulmonary parenchymal necrosis caused by an infective organism
- tissue destruction results in a solitary / dominant cavity measuring ≥2cm in diameter
  (Multiple cavities < 2cm → NECROTISING PNEUMONIA)
- Abscess >6 weeks = chronic

PATHOGENESIS

LUNG ABSCESS

PRIMARY

- in immunocompromised patients d/t infection by highly virulent organisms / aspiration of oropharyngeal / gastrointestinal secretions

↓

Necrotizing pulmonary infection

A. NECROTISING PNEUMONIA
- Staph aureus
- Klebsiella, Pseudomonas
- Mycobacterium
- Bacteroides, Fusobacterium, Actinomyces
- Entameba
- Echinococcus

B. ASPIRATION PNEUMONIA
- Anesthesia
- Stroke
- Drugs, alcohol

C. Esophageal Disease
- Achalasia
- Zenkeri diverticulum
- GERD

D. Immunodeficiency
- Cancer
- Chemotherapy
- Diabetes
- Organ transplantation
- Steroid therapy
- Malnutrition

SECONDARY

- in patients with an underlying condition
  - Partial bronchial obstruction
  - Lung infarct
  - Adjacent suppurative infections (Suphrenic / Liver abscess)

A. BRONCHIAL OBSTRUCTION

↓
- Neoplasm
- Foreign body

B. SYSTEMIC SEPSIS

↓
- Septic pulmonary embolism
- Seeding of pulmonary infarct

C. Complication of Pulmonary trauma
- Infection of hematoma or contusion
- Contaminated FB / penetrating injury

D. Direct extension of Extraparenchymal infection
- Pleural empyema
- Mediastinal abscess
- Liver abscess
- Subphrenic abscess

Clinical features

- Productive cough
- Fever >38.9°C
- Chills
- Leukocytosis
- Weight loss
- Fatigue, Malaise
- Pleuritic chest pain
- Dyspnea

May present in an indolent fashion also

Aspiration $\xrightarrow{1-2 \text{ weeks}}$ Cavitation

- PUTRID, FOUL-SMELLING SPUTUM

Rupture into pleural space → pyopneumothorax

Rupture into bronchial tree → Massive hemoptysis
endobronchial spread to other areas of lungs

Evaluation

- CXR - thin walled cavity ± air-fluid level
  - ↳ communication ± tracheobronchial tree
- CT - to s/o
  - endobronchial obstruction
  - Associated mass
  - Cavitating lung cancer
  - Loculated/ Interlobar empyema
  - Infected lung cysts / bullae / bronchiectasis
  - Fungal infections
  - Necrotising granulomas - Wegner's

- Culture of aspirates
- Evaluation of i/c - HIV
  T2DM

MANAGEMENT

1) Systemic antibiotics - mainstay (3-12 weeks)
   treat till cavity resolves
   - β-lactams
   - Clindamycin

Drainage usually occurs spontaneously via tracheobronchial tree

2) INDICATIONS FOR SURGICAL DRAINAGE

1) Failure of medical therapy
2) Abscess under tension
3) Contralateral lung contamination
4) >4-6cm
5) Rupture / Pyopneumothorax
6) Inability to exclude a cavitating carcinoma

PROCEDURES

- External Drainage - TUBE THORACOSTOMY
  IMAGE GUIDED THORACOSTOMY TUBES
- Surgical Resection — Required in <10% cases

LOBECTOMY - procedure of choice for
- bleeding from lung abscess
- pyopneumothorax

INTRA-OPERATIVELY - Contralateral lung should be protected with a
double lumen tube
bronchial blocker
Contralateral main stem intubation

SURGICAL APPROACHES TO THE THORAX

- VIDEO - ASSISTED THORACIC SURGERY (VATS)
- ROBOT - ASSISTED THORACIC SURGERY (RATS)

2-4 (0.5-1.5cm) incisions for
- access / view
- dissection
- Retraction

Endoscopic staplers are used for the division of major vascular structures and bronchial elements

- becoming the recommended approach for

- treatment of pleural effusions, recurrent pneumothoraces
- lung biopsies
- lobectomies, pneumonectomies
- segmental resections
- Resection of bronchogenic/mediastinal cysts
- intrathoracic esophageal mobilization for esophagectomies

- OPEN SURGICAL APPROACHES

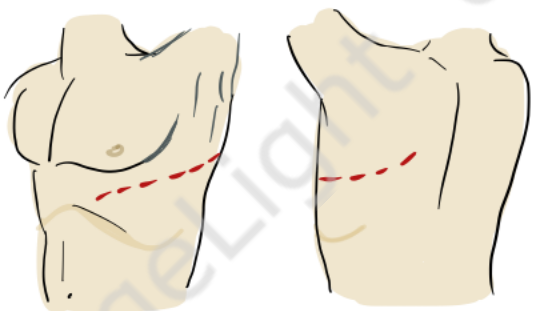
1) POSTEROLATERAL THORACOTOMY
- for most pulmonary resections
  esophageal operations
  operations in posterior mediastinum
  vertebral column

2) ANTEROLATERAL THORACOTOMY
- in trauma victims
- allows quick access into chest when patient is supine
  (Lateral decubitus compromises resuscitation)

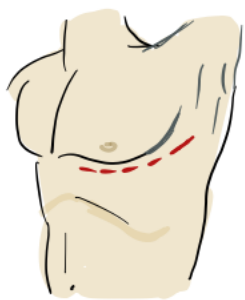
3) 'CLAMSHELL' THORACOTOMY
- Bilateral anterolateral thoracotomy ± TRANSVERSE STERNOTOMY
  - for heart & mediastinum

4) 'HEMICLAMSHELL'/'TRAPDOOR' THORACOTOMY
Anterior thoracotomy + Partial median sternotomy - mediastinal access

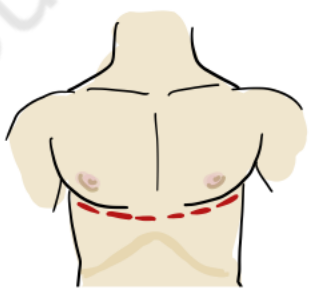
5) MEDIAN STERNOTOMY
- exposure of anterior mediastinum
  ↳ m/c used for cardiac surgery



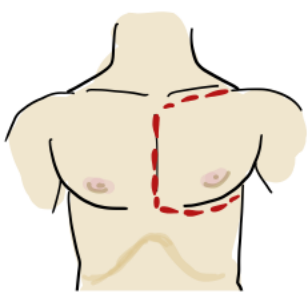
POSTEROLATERAL THORACOTOMY



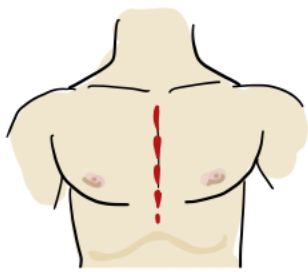
ANTEROLATERAL THORACOTOMY



CLAMSHELL THORACOTOMY



HEMICLAMSHELL/ TRAPDOOR THORACOTOMY



MEDIAN STERNOTOMY

PHARYNGOCELE

- outpouching of the pharynx resulting from the herniation of the Lateral pharyngeal walls.
- Multifactorial
  - ↑ Intraphayngeal pressure
  - Loss of phayngeal muscle resilience - aging
- Men > women
- 5th–6th decade
- LOCATION: 2 areas of anatomical weakness of Lateral phayngeal walls

JUNCTION OF SUPERIOR CONSTRICTOR MIDDLE CONSTRICTOR

↓

Ostium of the phayngocele is at the inferior pole of the palatine tonsil at the lateral side of the vallecula

JUNCTION OF MIDDLE CONSTRICTOR INFERIOR CONSTRICTOR

↓

ostium at the base of the pyriform sinus

Symptoms - Dysphagia

Regurgitation

can added pharyngeal diverticula

↓

Zenker

Lairmer

Barium swallow

MRI for large phayngoceles

℞ - Excision & Repair