Schweizerische Gesellschaft für Oto-Rhino-Laryngologie, Hals- und Gesichtschirurgie
Société suisse d'Oto-Rhino-Laryngologie et de Chirurgie cervico-faciale
Società Svizzera di Otorinolaringoiatria e di Chirurgia cervico-facciale

Sommerschule, école d'été 2017
25.08.2017
diagnostic imaging in H&N tumours

P
Prof. Dr. Bernhard Schuknecht, Medizinisch Radiologisches Institut Zürich (MRI)
bschuknecht@mri-roentgen.ch

PD Dr. Gerhard F. Huber, USZ
gerry.huber@usz.ch

Order of „business“

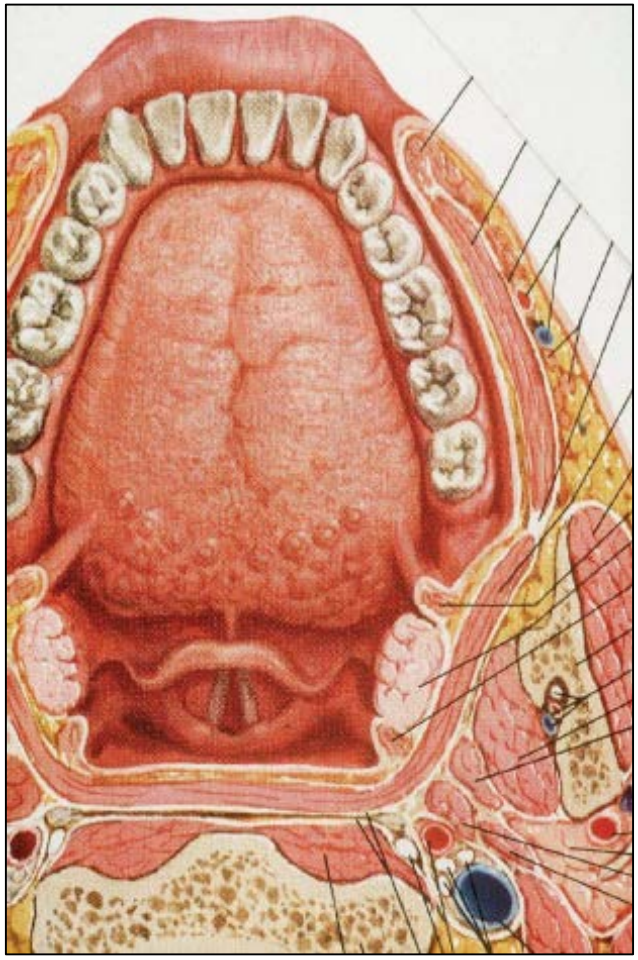
- **morphologic and «advanced " diagnostic imaging**
- supra- & infrahyoid pharyeal- and neck-*spaces* !

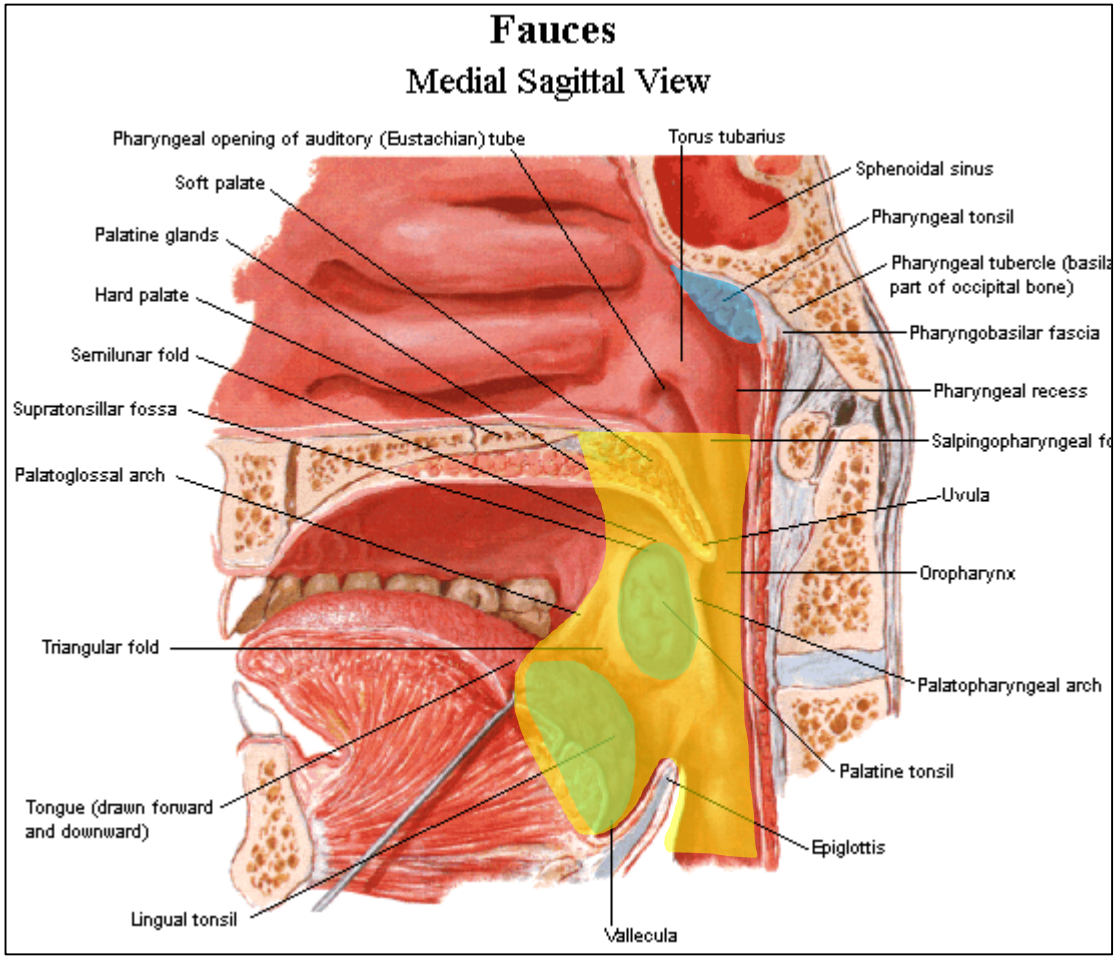
locations

oral cavity
oropharynx
larynx
hypopharynx
(nasopharynx)

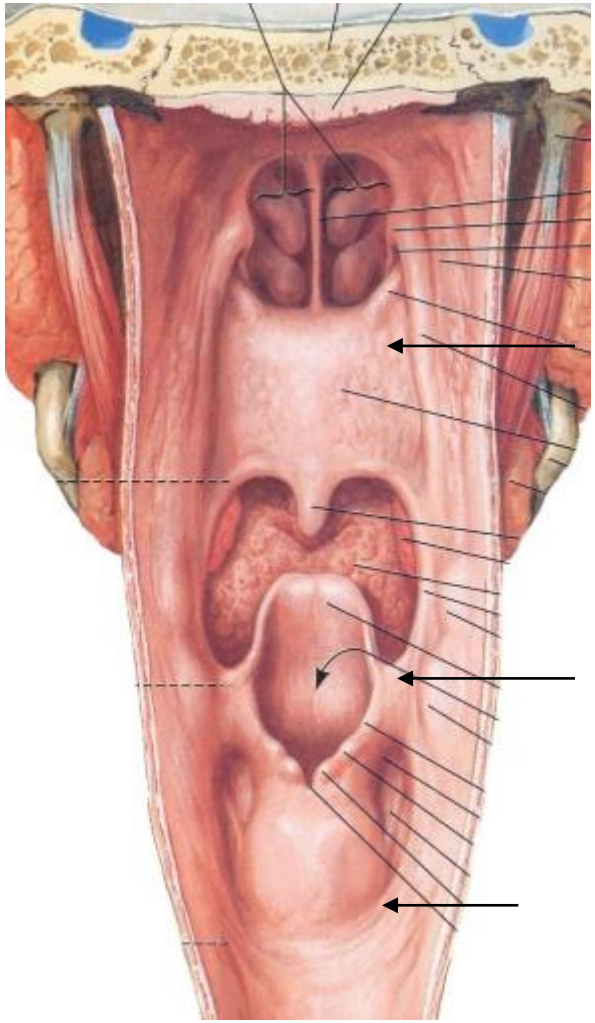
- salivary glands => parotid gland
- parapharyngeal space
- masticator space
- carotid space
- perineural spread

anatomy of the oral cavity and orophaynx





anatomic division of the pharynx
naso-(epi), meso- (oro), hypopharynx



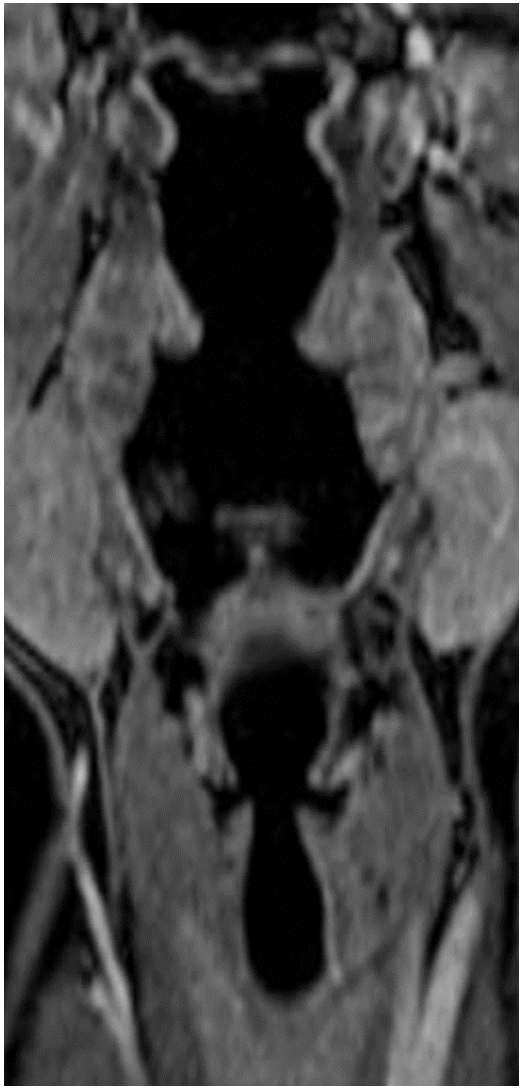
nasopharynx

skull base – soft palate

oropharynx
soft palate – pharyngo-epi-glottic fold

Hypopharynx

- cricopharyngeus m.



Sobotta Becher 2nd ed. U&S 1972

deep cervial fascia

= key for understanding H&N Anatomy

deep cervical fascia →

- superficial layer
- middle
- deep

divides neck in

spaces

suprahyoidal ↔ infrahyoidal

fasciae: propability of different tumours

relevance for surgical treatment?

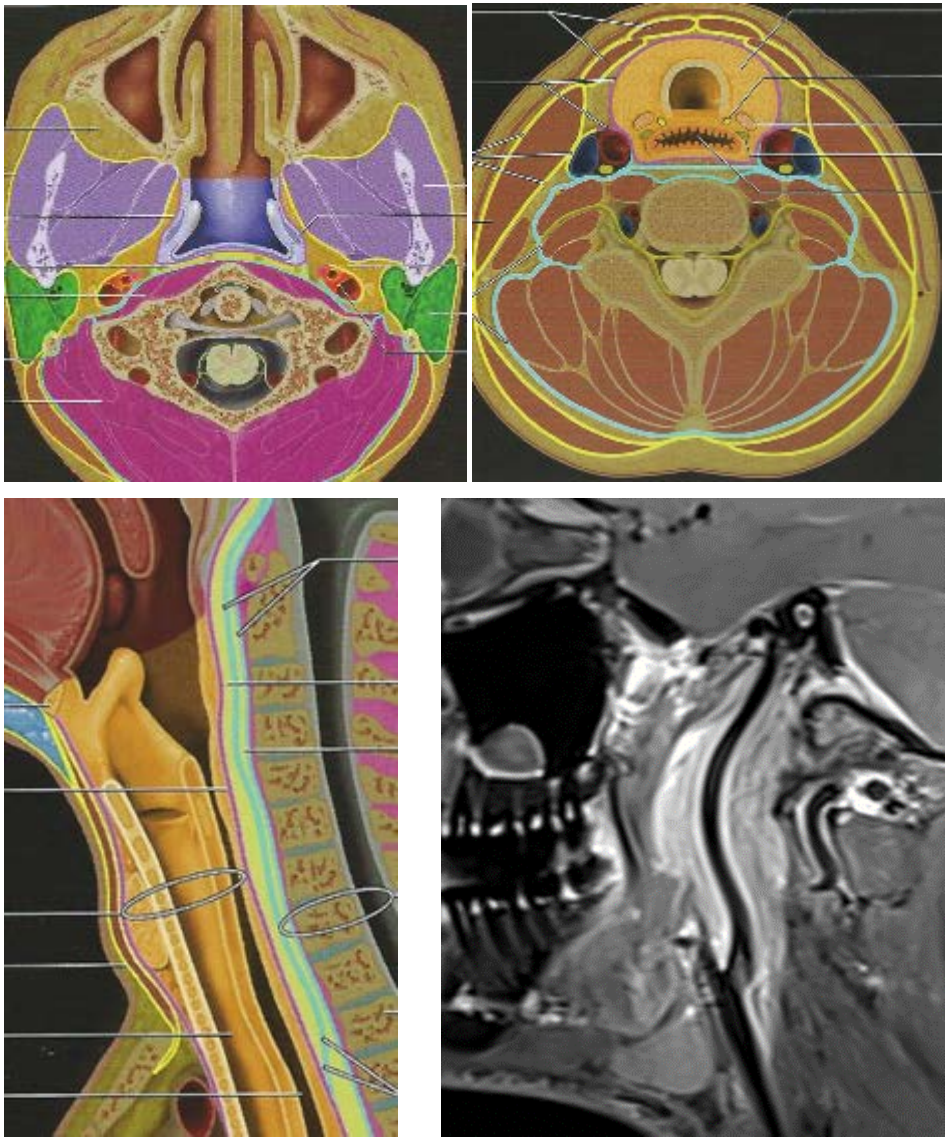
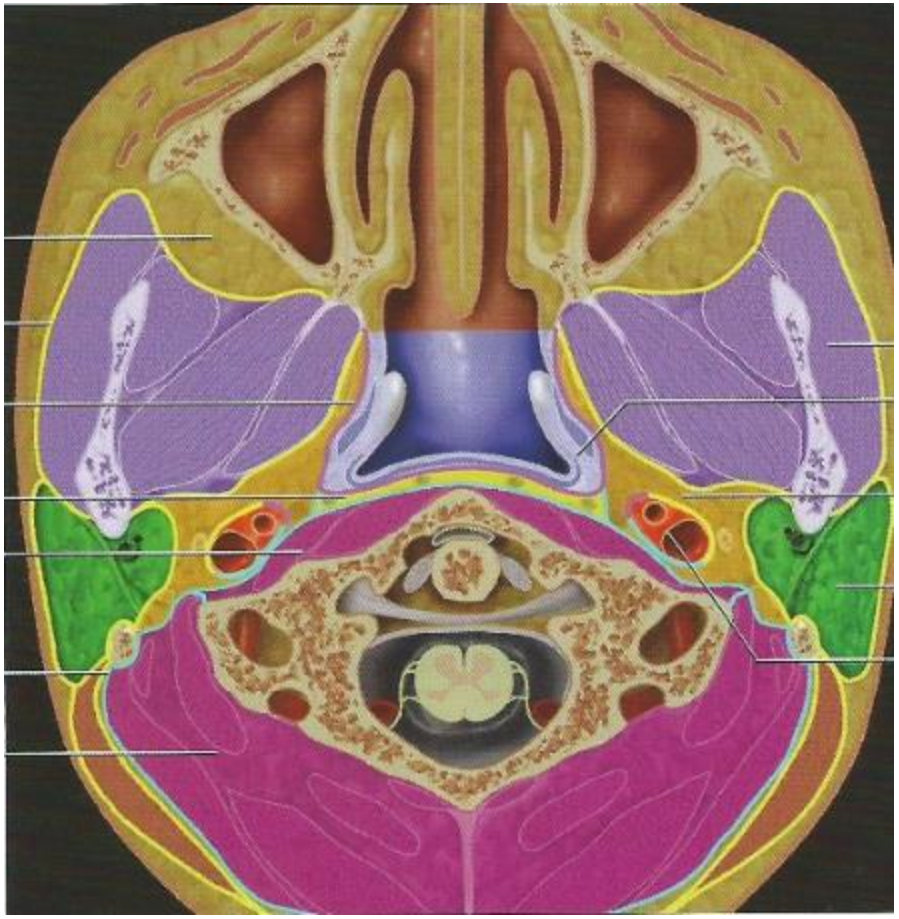
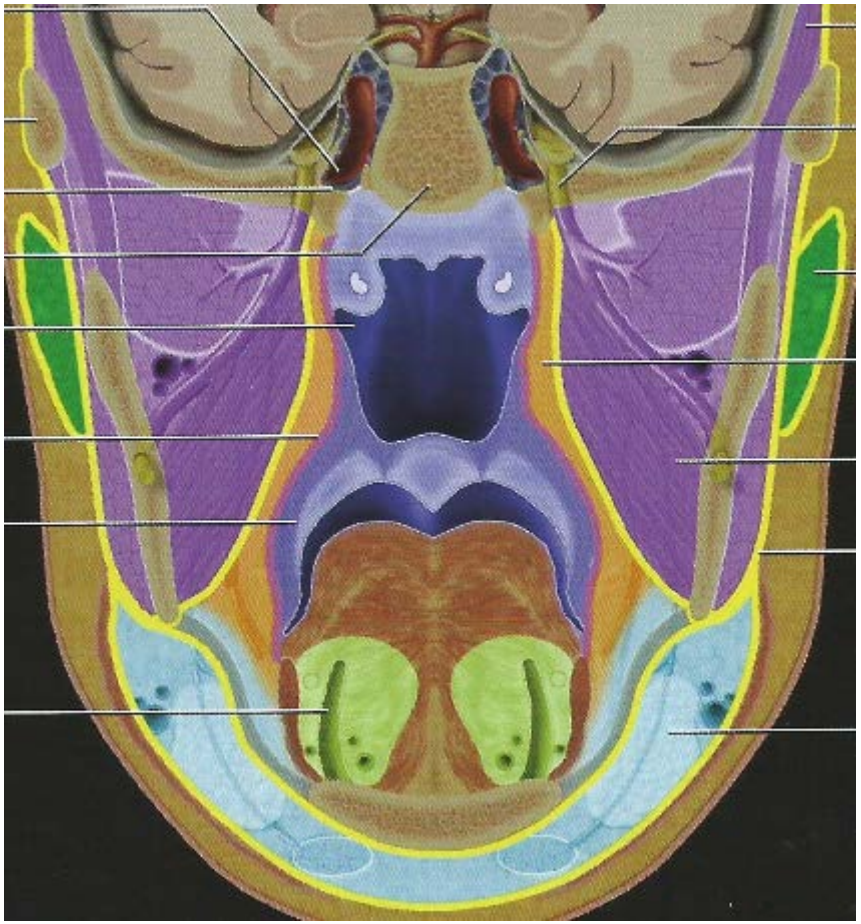


Fig. Harnsberger Ed. Diagnostic Imaging Head and Neck 2nd ed : Amirsys 2011

suprahyoidal

superficial : parotid-, masticator-, submandibular- space, parapharyngeal- & carotid- space

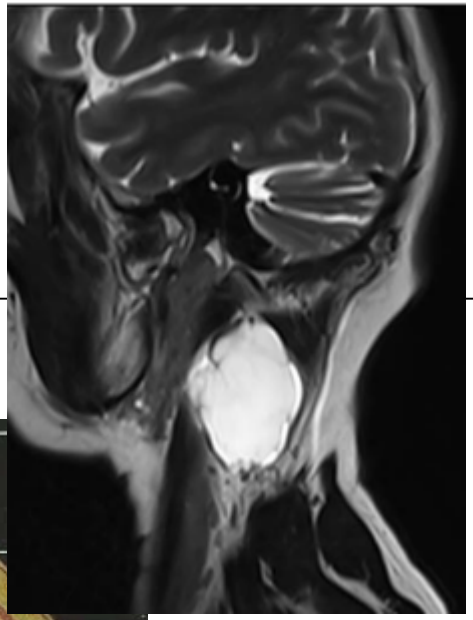




middle: pharnygeal mucosal space, retropharyngeal space

depp: retropharyngeal space, prevertebral space

infrahyoidal



- **infrahyoidal**
  - visceral space
  - anterior cervical space
- **supra- /infrahyoidal**
  - carotid space
  - retropharyngeal / «danger» space
  - pre- (peri-)vertebral space
  - posterior cervical space

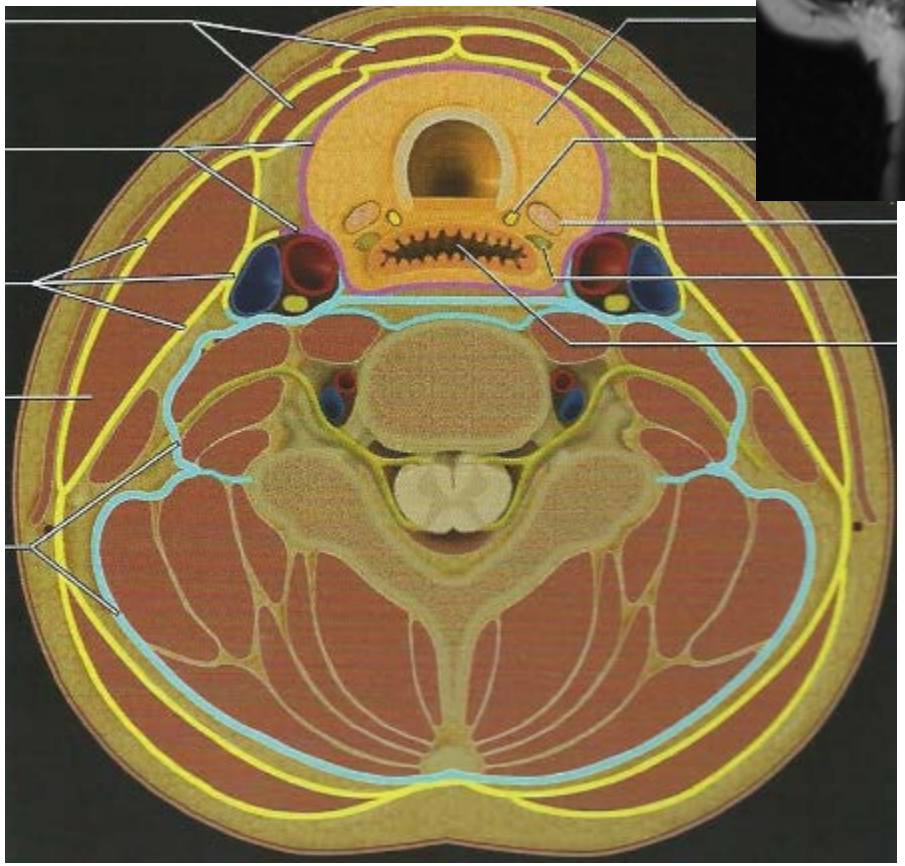
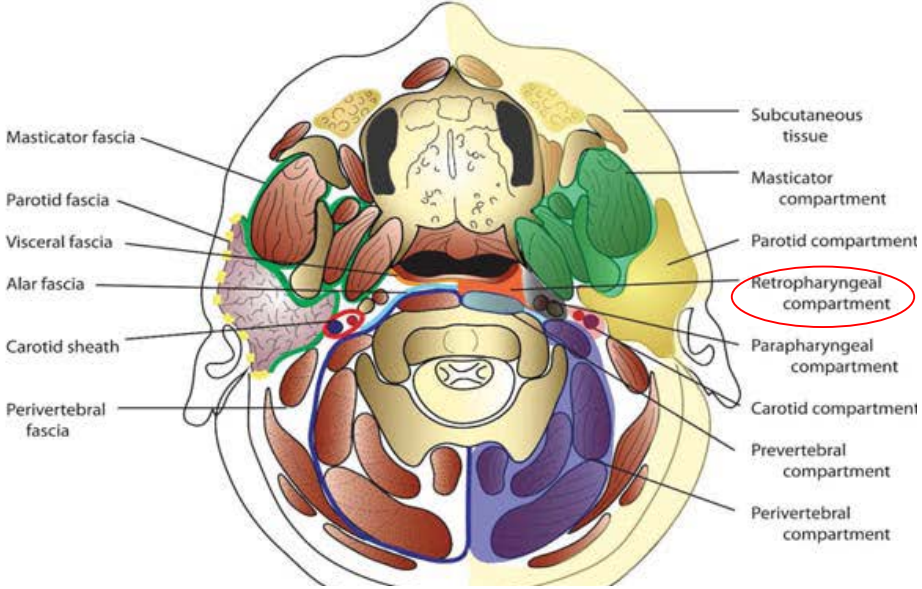


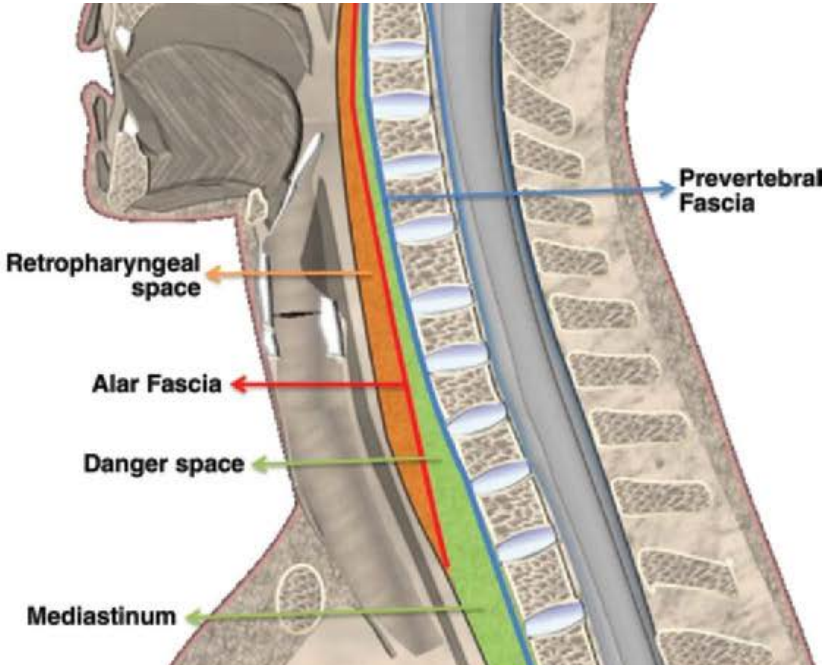
Fig.Harnsberger Ed. Diagnostic Imaging Head and neck 2nd ed. I1 4,6; Amirsys 2011

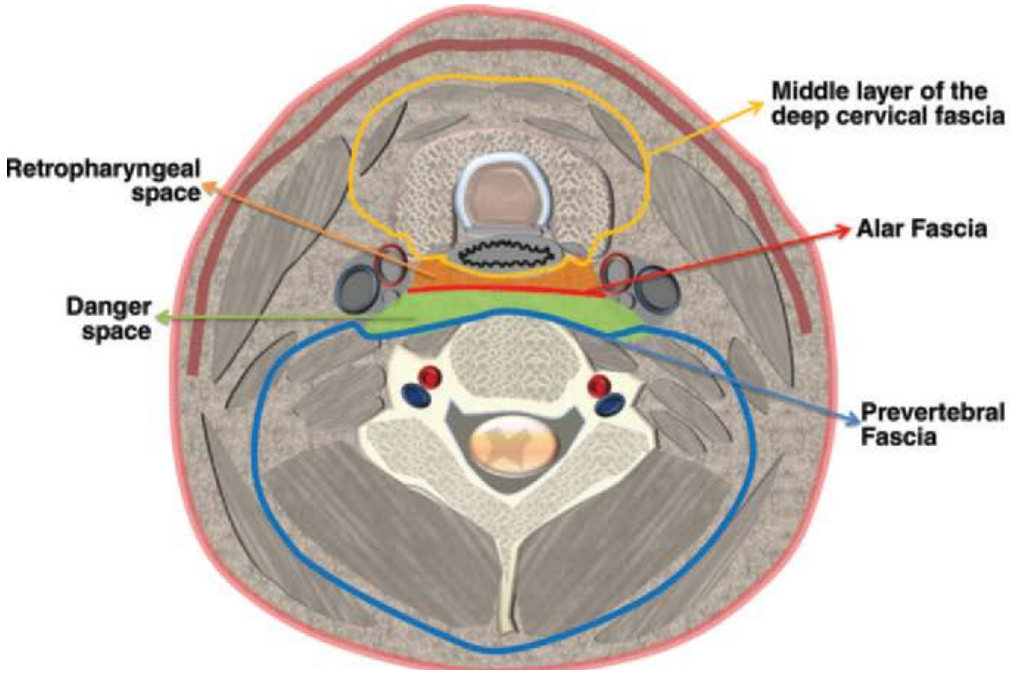
Spaces ?

Retropharyngeal + danger space
= Retropharyngeal compartment



Guidera AK et al. Head and neck fascia and compartments: No space for spaces. HEAD & NECK—DOI 10.1002/HED 2014





Katabathina V et al. Nonvascular, Nontraumatic mediastinal emergencies in adults: a comprehensive review of imaging findings. RadioGraphics 2011; 31:1141–1160

tasks of diagnostic imaging
relevant information for therapy planning

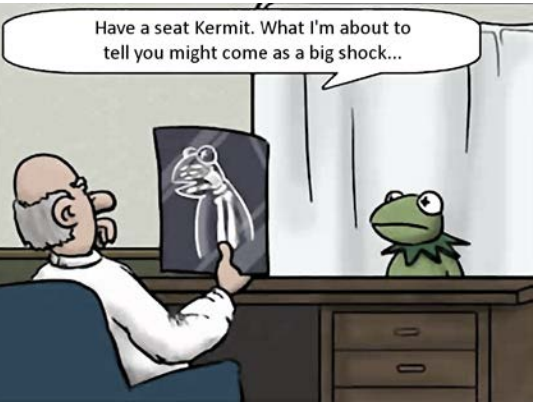
---

1. tumour location ?
   initial starting point → e.g. tonsil vs adjacent mesopharynx
2. tumorextension ?
   infiltration into deep, breaching of midline, bone- cartilage-, nerve-, vascular- involvement
3. involvement of lymph nodes?
   cervical, retropharyngeal, mediastinal - fascial (parotid)
   criteria - staging !
4. course during and after therapy
   local, systemic, surgical

role of diagnostic imaging

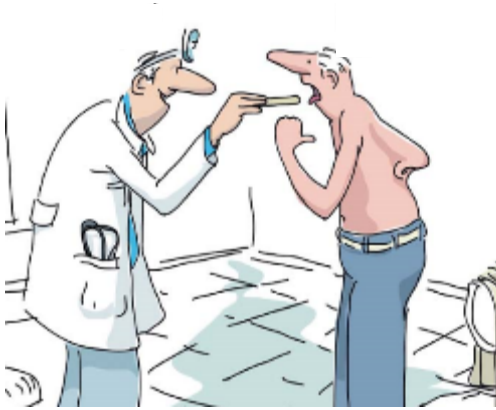
different questions in different phases of treatment

diagnosis



treatment

follow-up



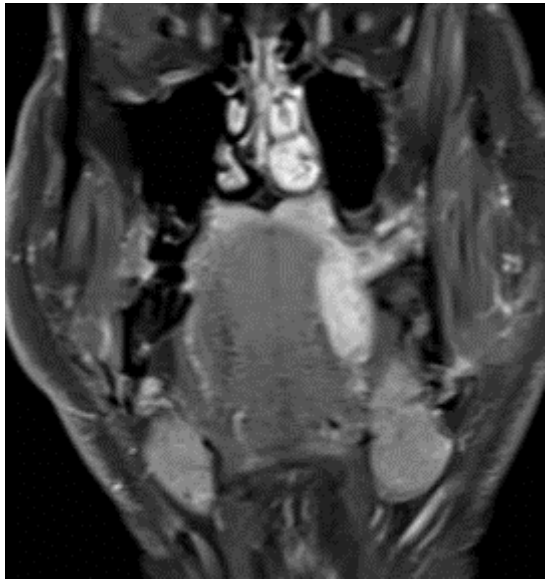
Staging : mesopharynx and oral cavity

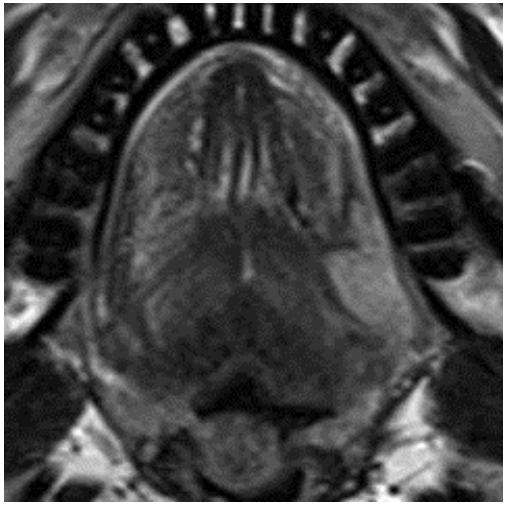
- **T1 Tu ≤ 2 cm maximum diameter**
- **T2 Tu > 2 cm ≤ 4 cm maximum diameter**
- **T3 Tu > 4 cm maximum diameter**
- **T4a Tu infiltrating supragl. larynx, extrinsic musculature,** potentially resectable
- **T4b Tu infiltrating masticator space, skull base, ICA**

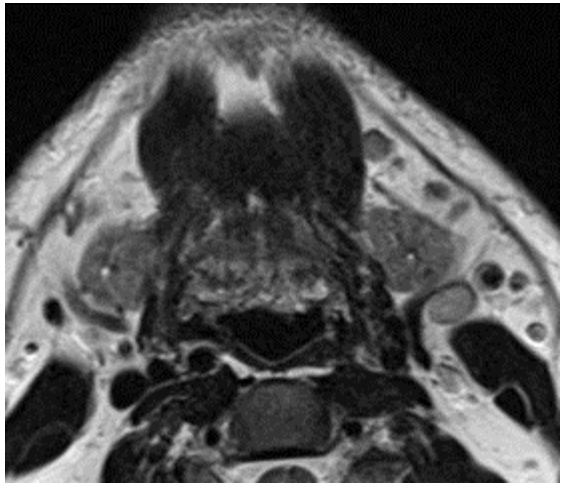
carcinoma of the oral cavity

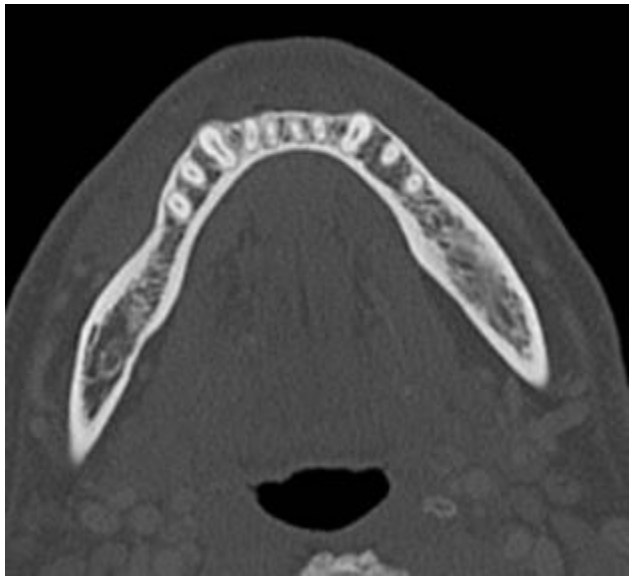
- lower lip > tongue >FOM
- involvement of LN: 30-70% initially
- prognosis: ↓ anterior tw posterior
- crossing the midline
- infiltration of extrinsic tongue musculature, bone or supraglottic larynx

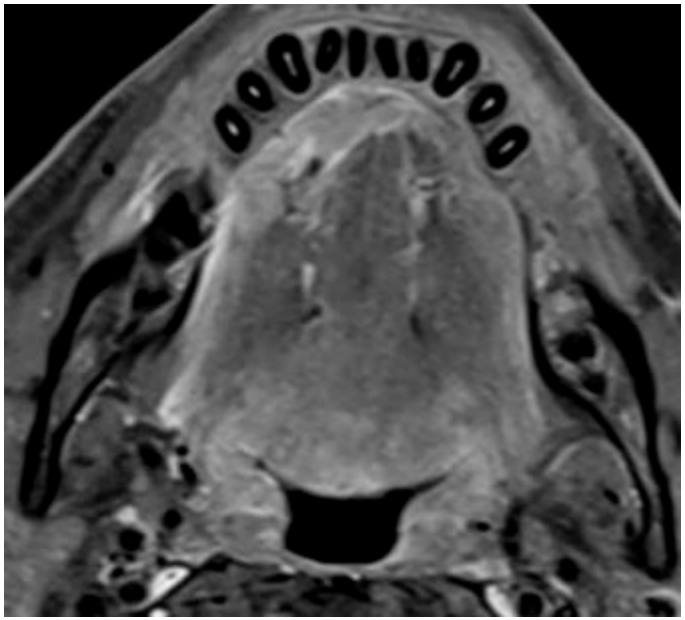
tongue cancer

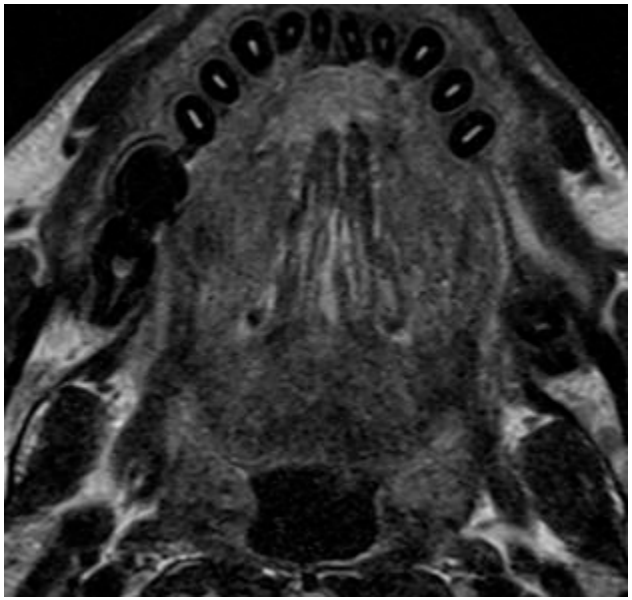






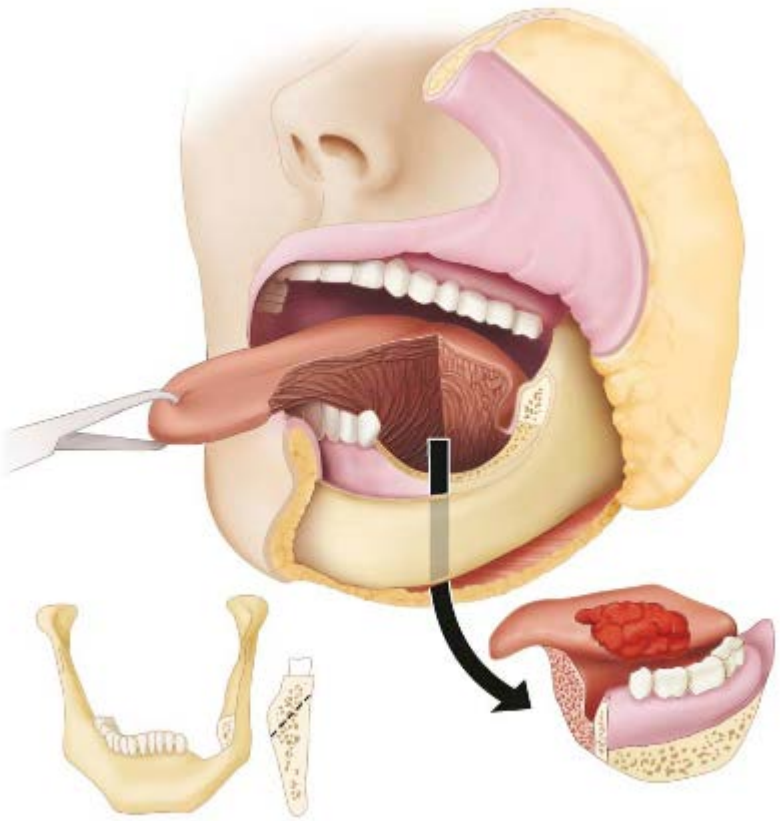


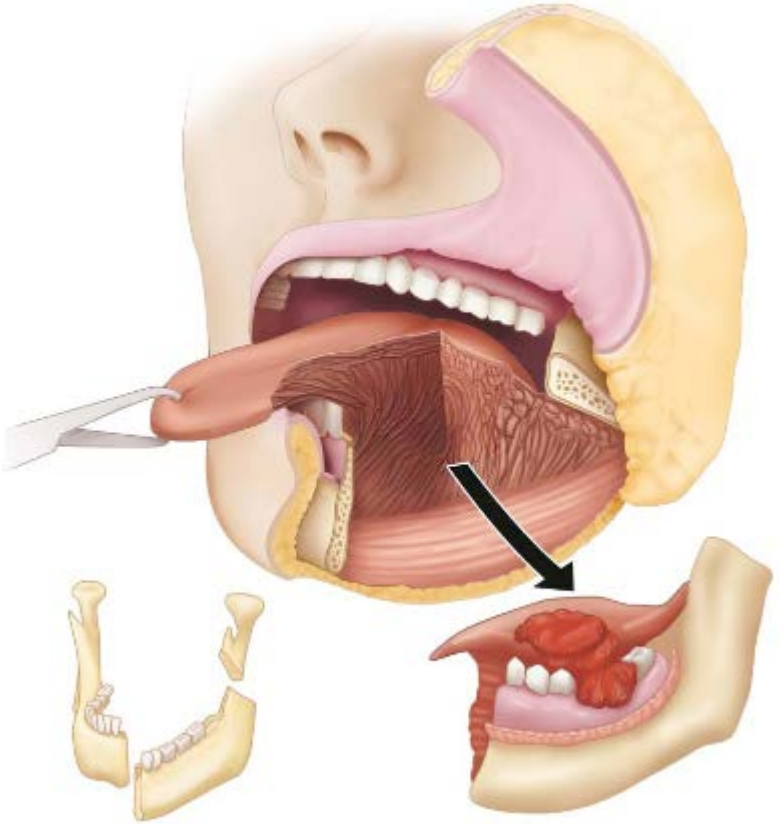




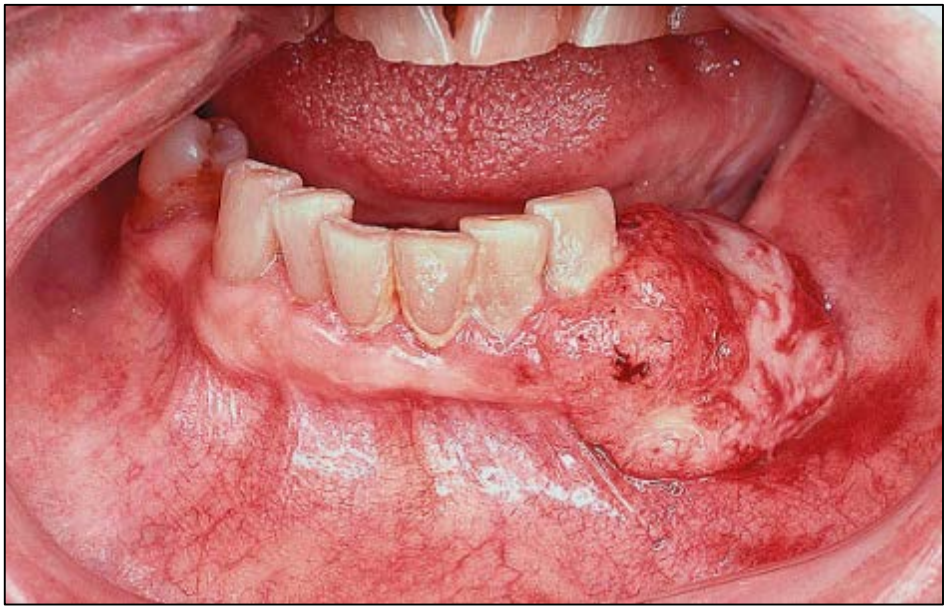
Floor of Mouth Ca
T2, N1

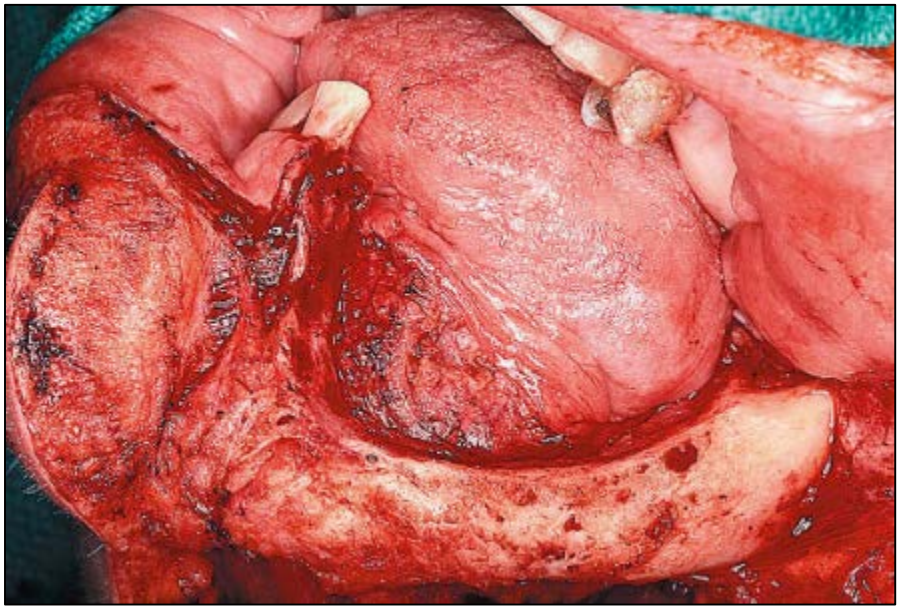
marginal mandibulectomy



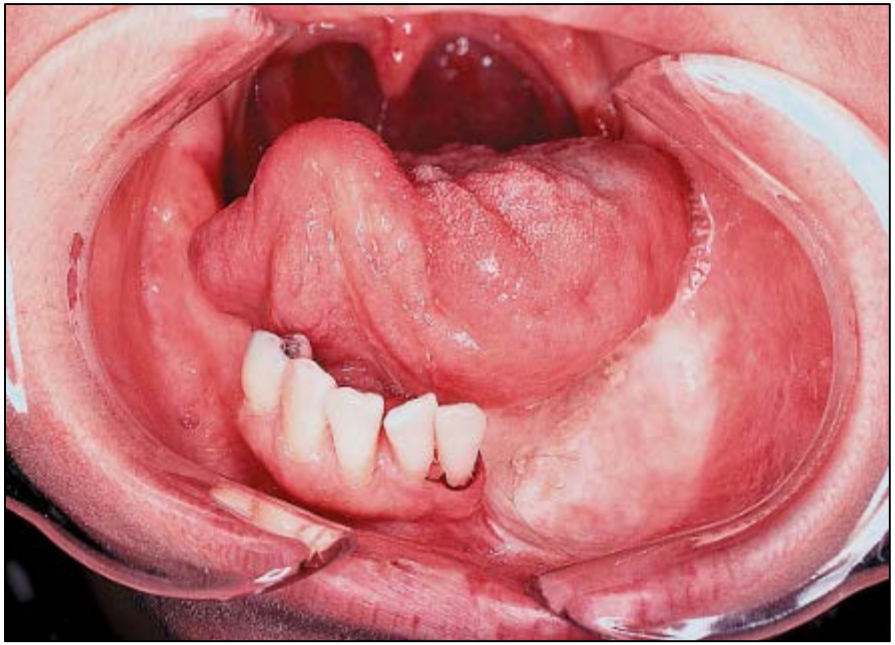


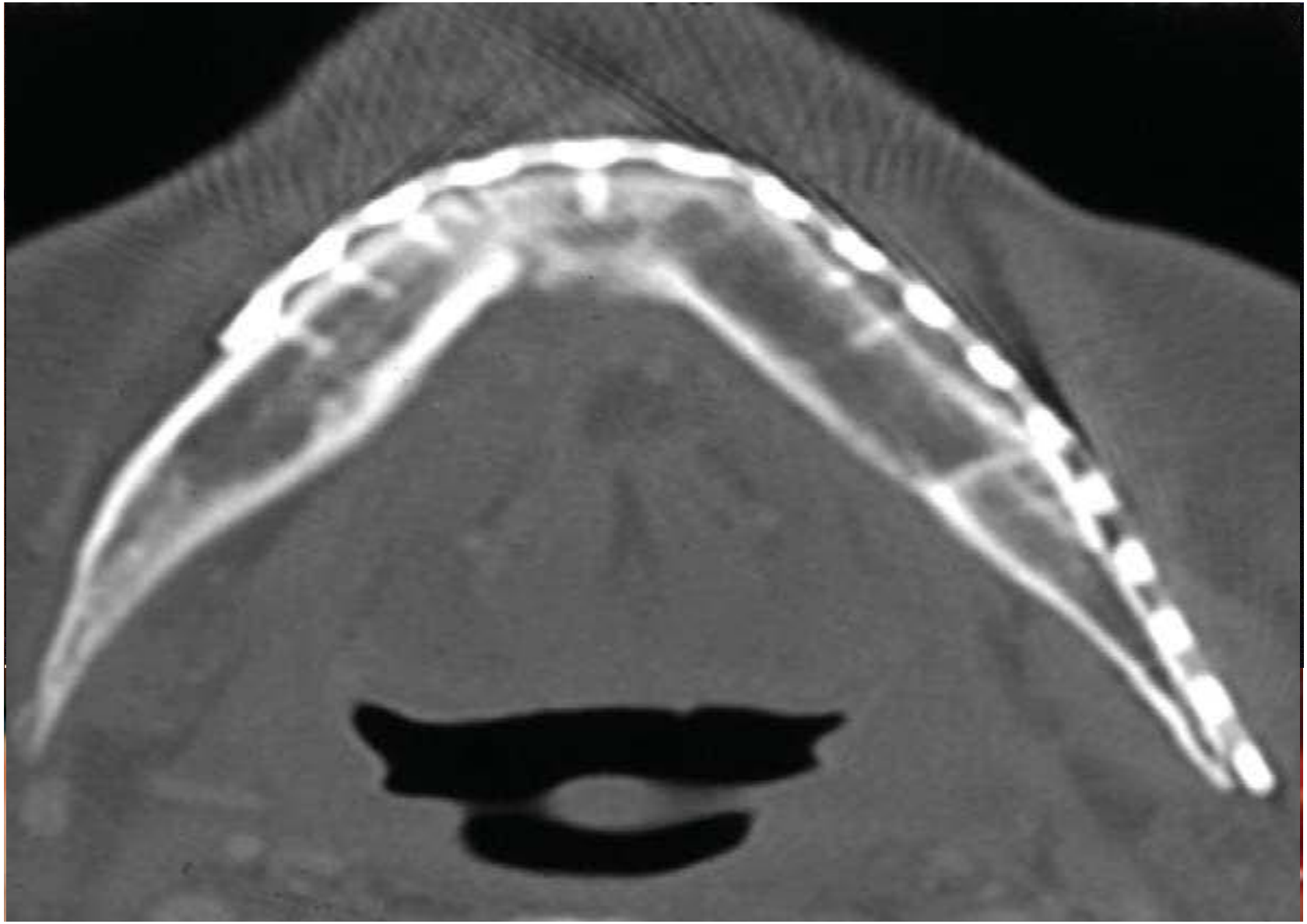
segmental mandibulectomy





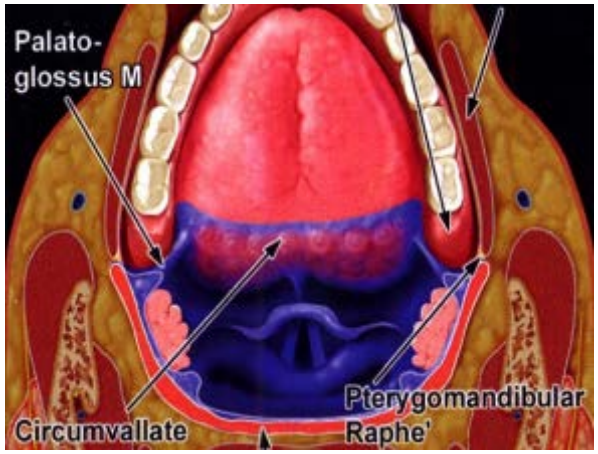
METRIC1
2
3
4
5
6
7

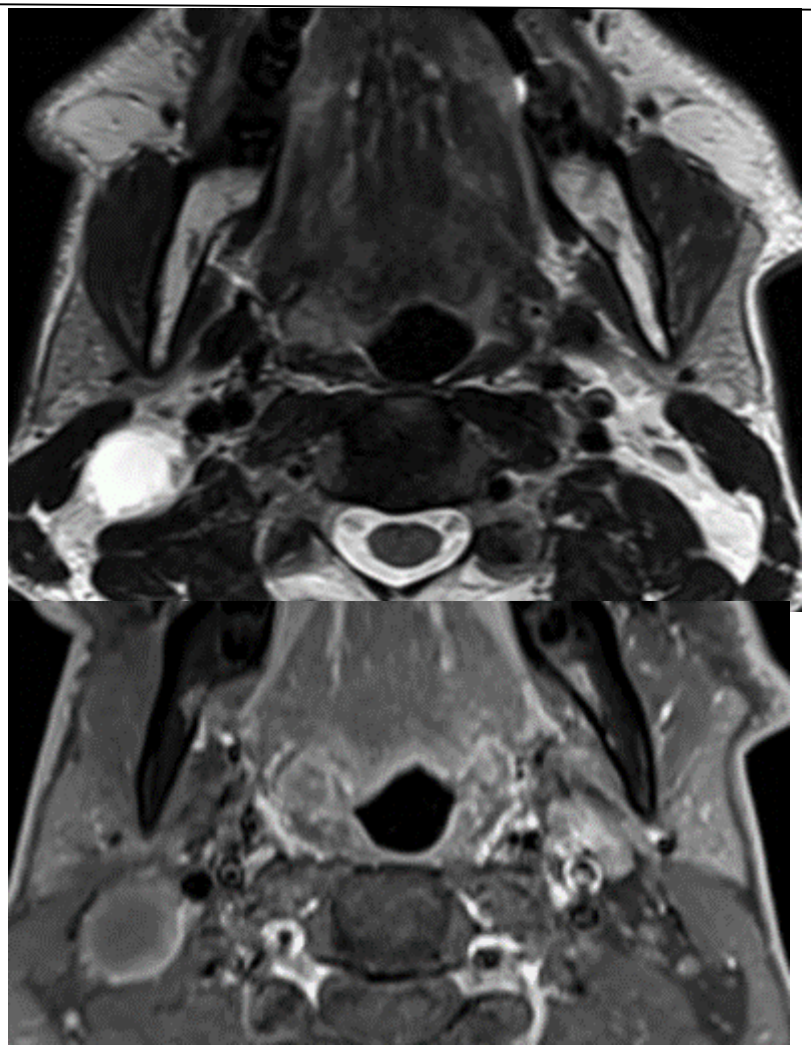




Mesopharynx

neoplasms
tonsil 50%,
base of tongue 20%,
soft palate 10%
pharygeal wall 10%



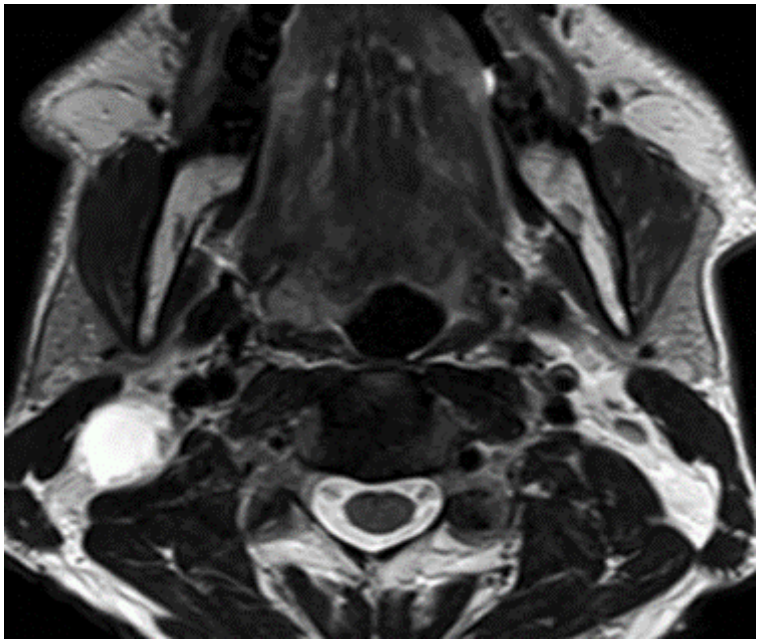


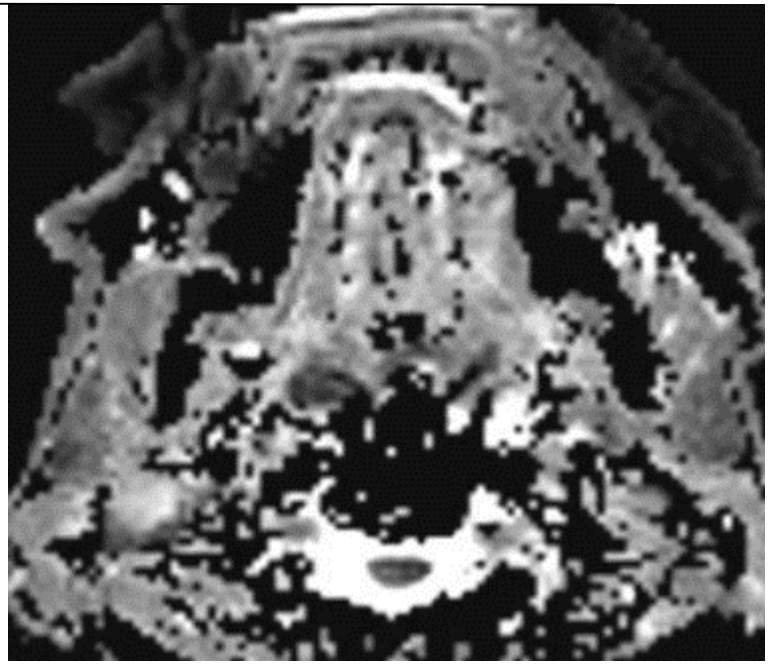
54y,m; lump on right mandibular angle, ↑ 4 weeks

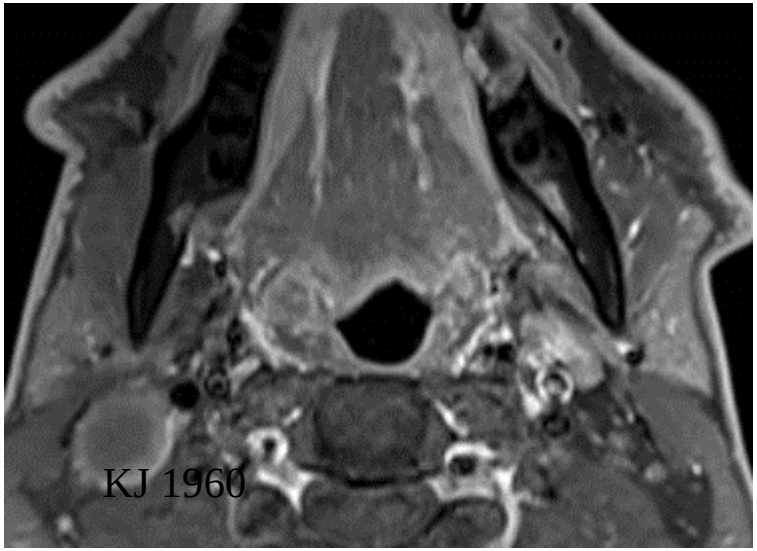
Mesopharynx

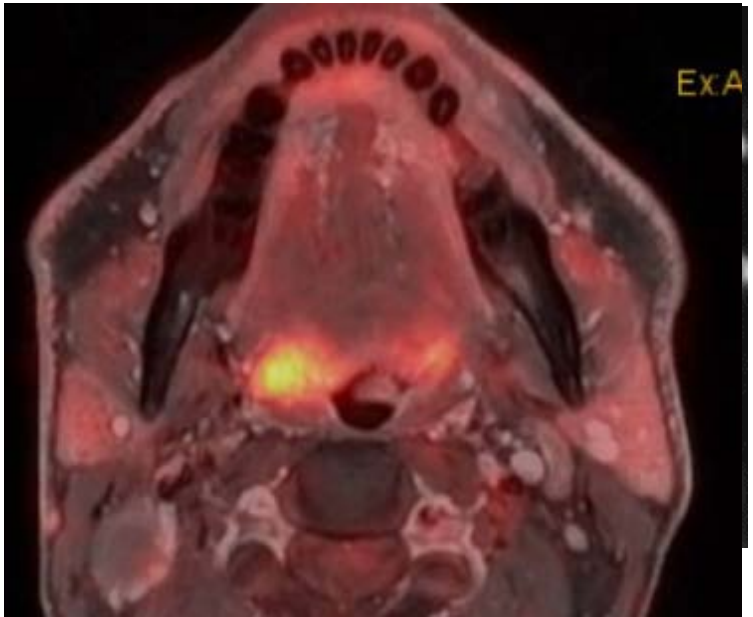
1ary ?

tonsillar-ca

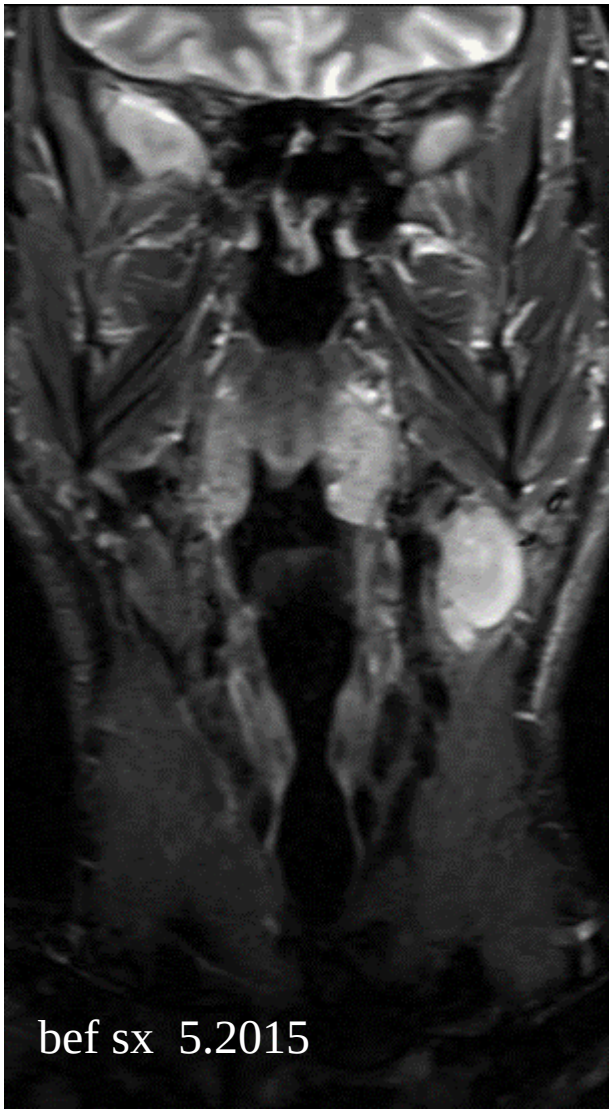


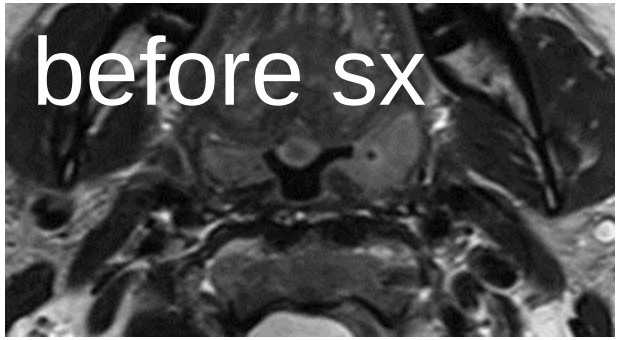


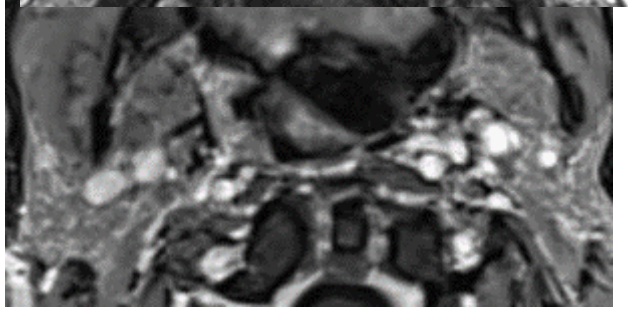




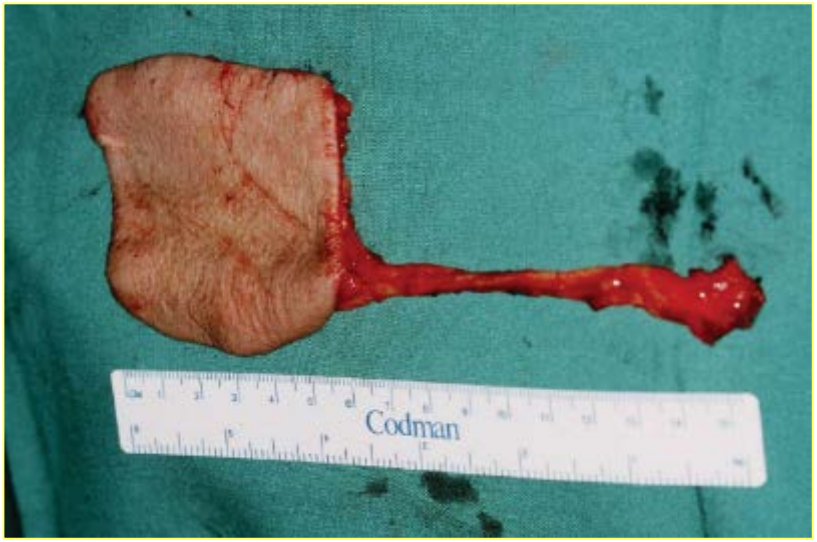
transoral tu resection, RFFF and ND I-IV left



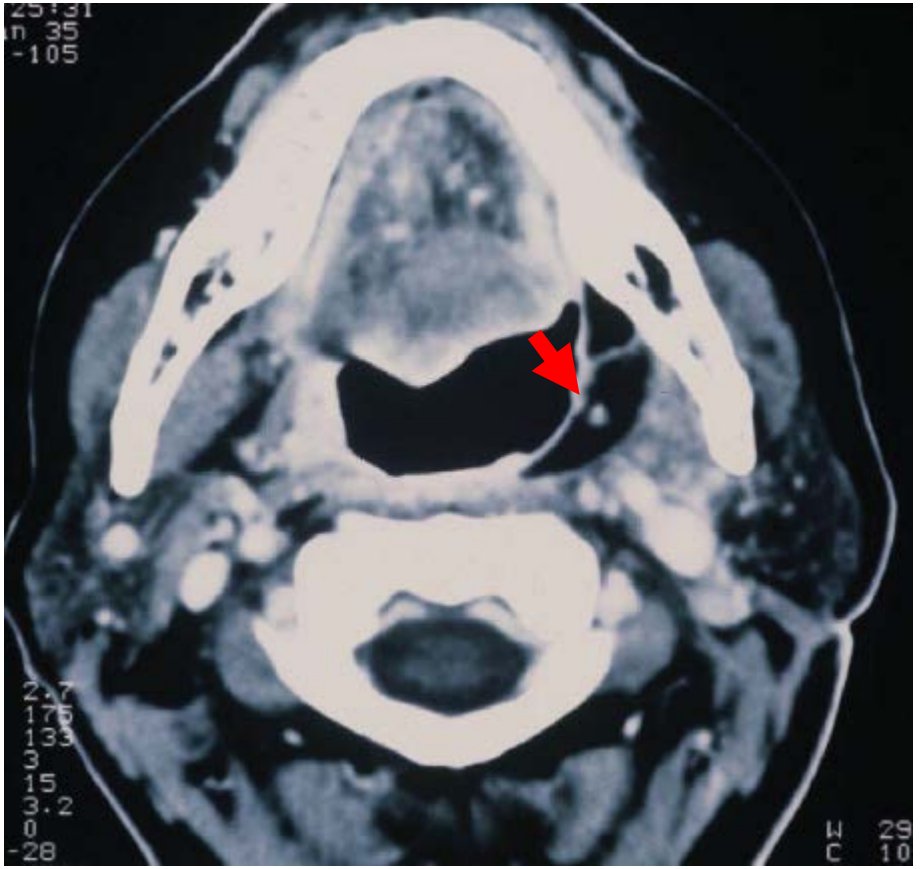


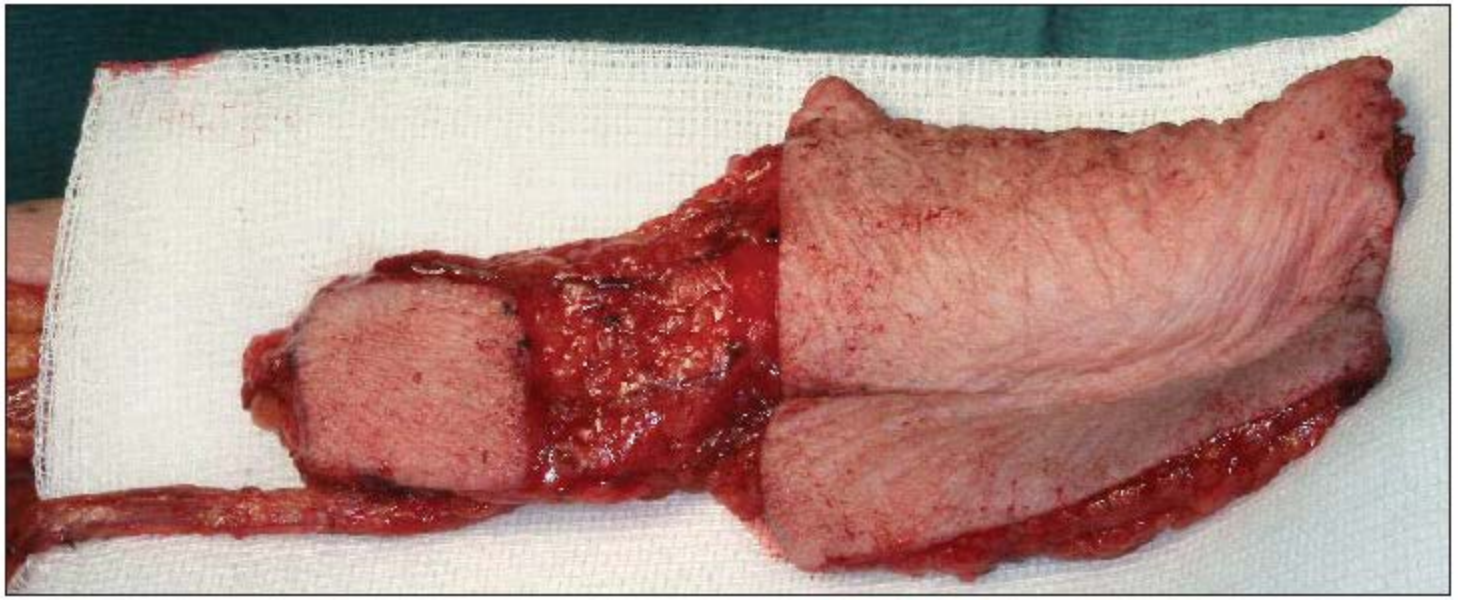


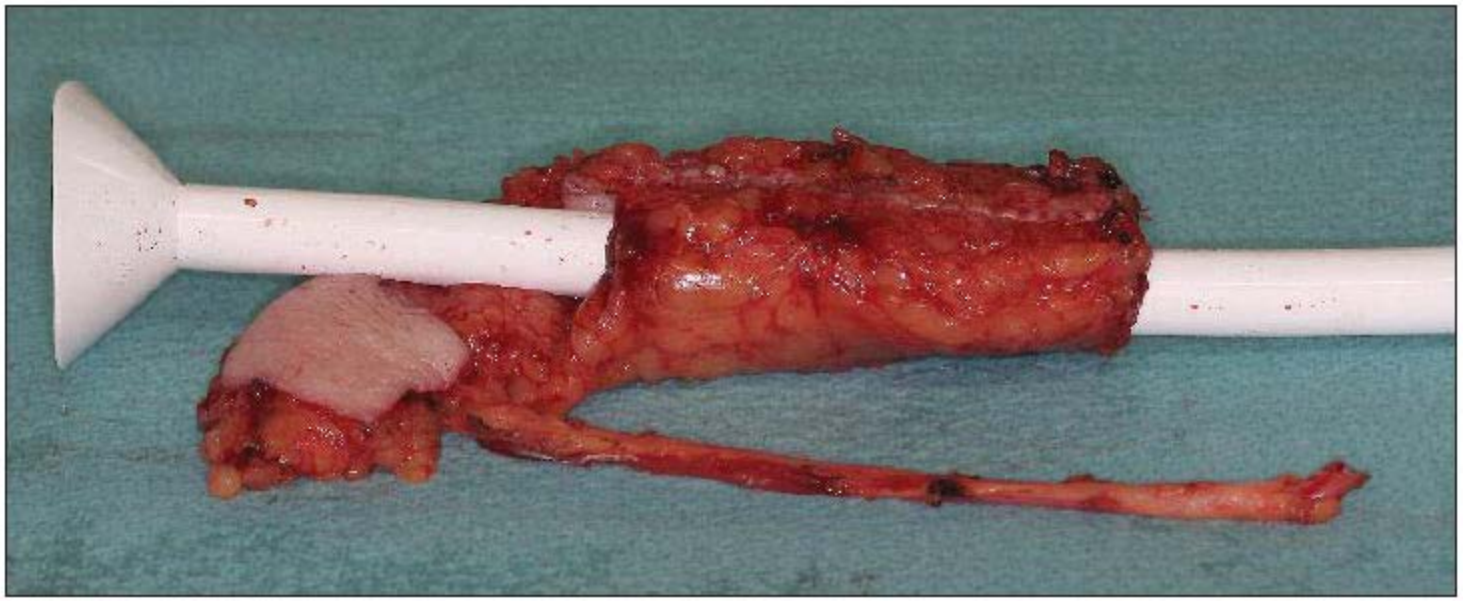
changed anatomy after sx with flap reconstruction



changed anatomy after sx with flap reconstruction





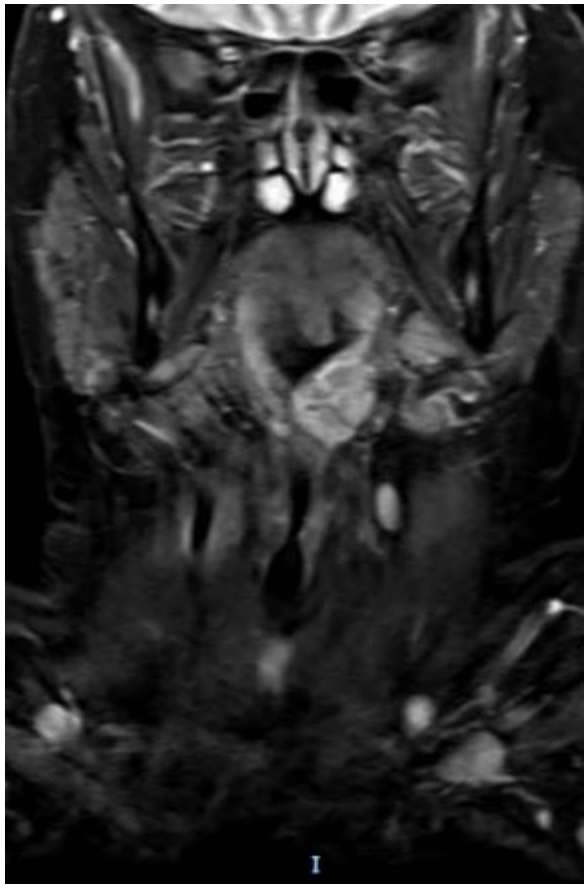


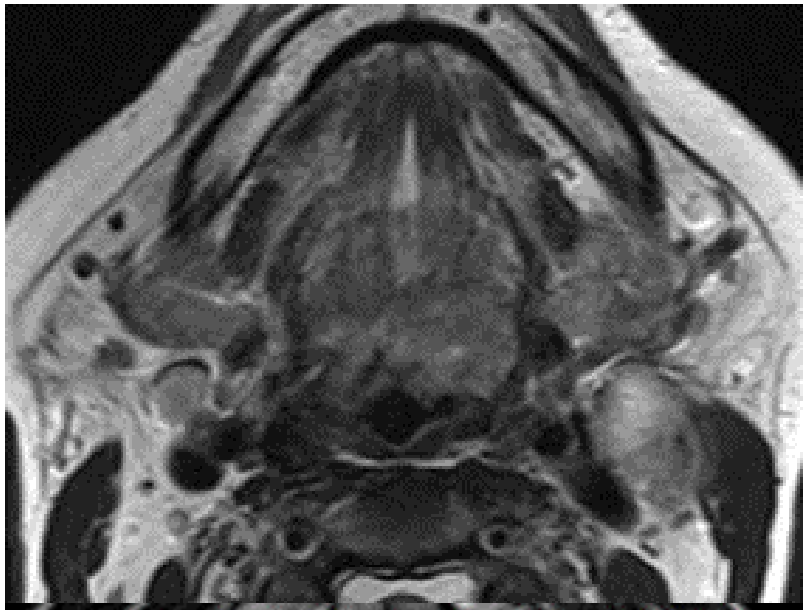
staging carcinomas of mesopharynx and oral cavity

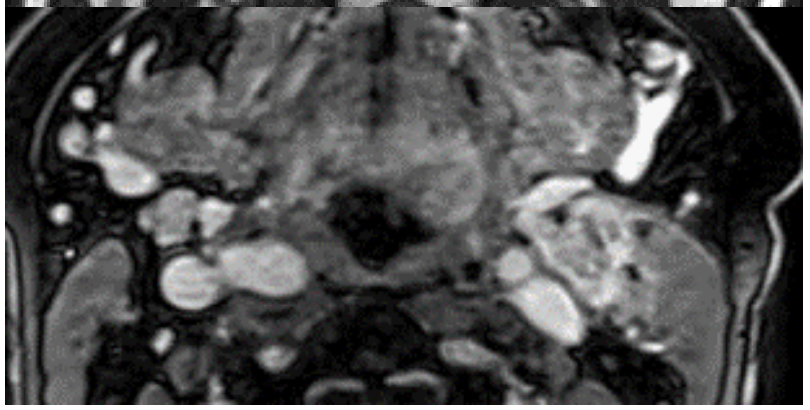
- **T1 Tu ≤ 2cm maximal extension**
- **T2 Tu > 2cm ≤ 4cm maximal extension**
- **T3 Tu > 4cm maximal extension**
- **T4a Tu infiltratomg supragl. larynx, extrinsic musc.,**
  potentially resectable
- **T4b Tu infiltrating masticator space, skull base, ICA**

strategy of investigastion: **3 planes**

1. sag T2, 2. cor STIR, 3. ax: T2, T1 ± Gd,

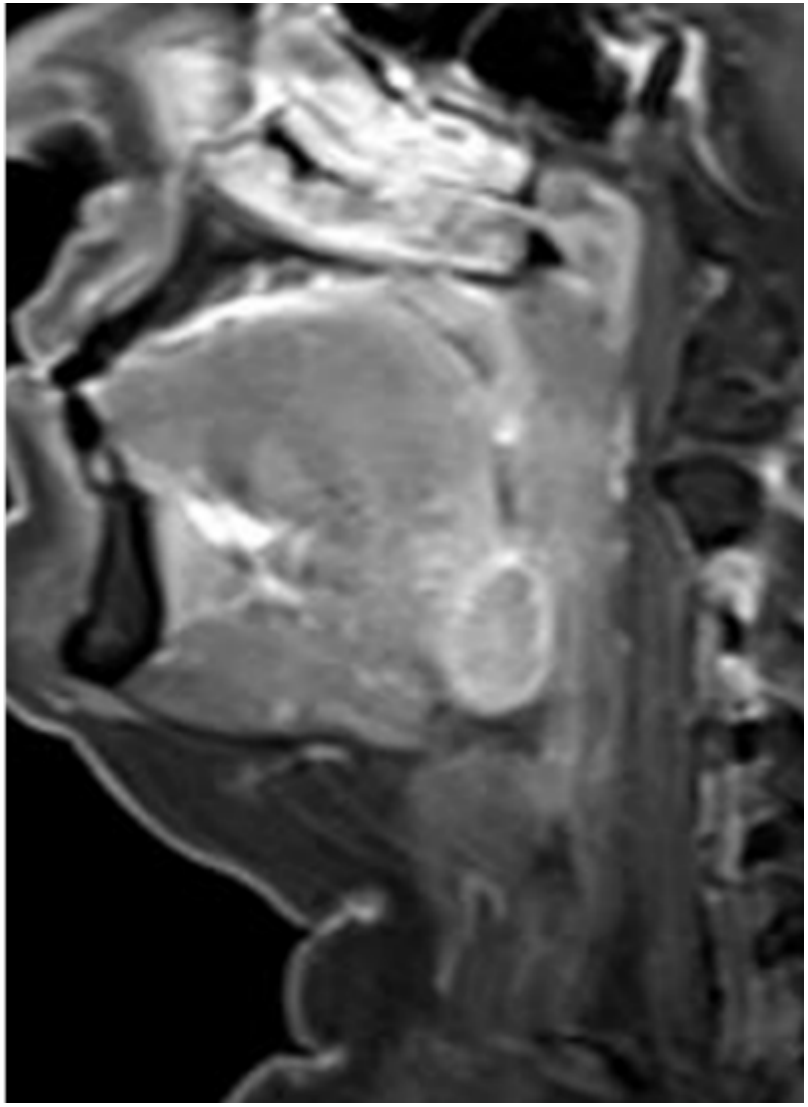






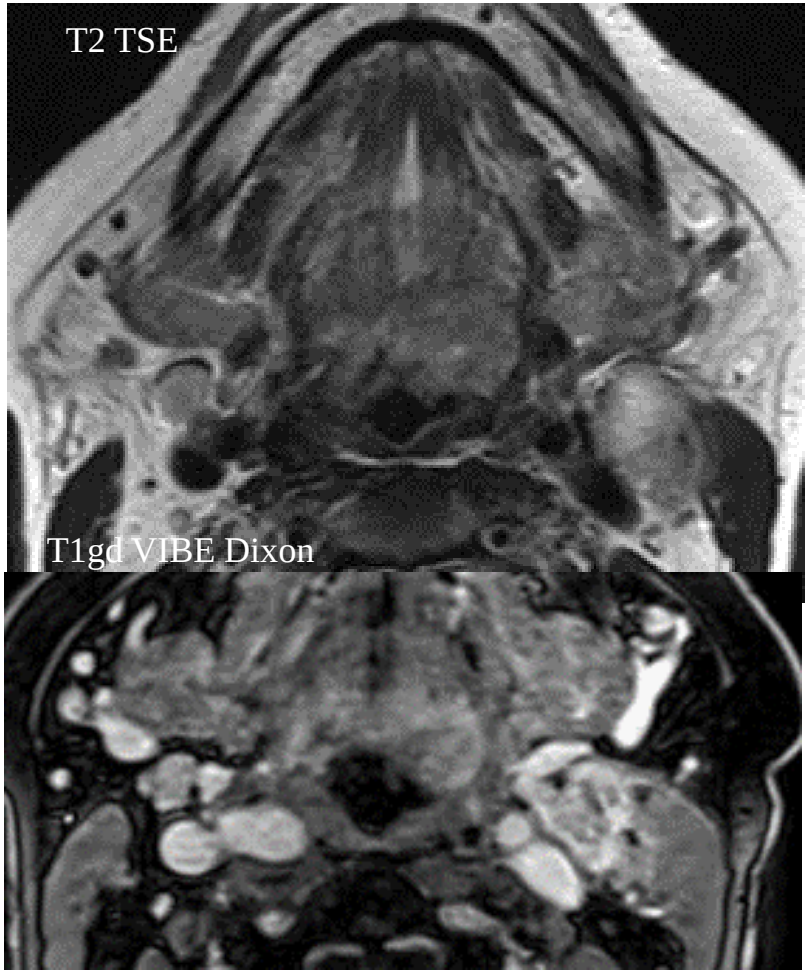
J M 23.12.1953

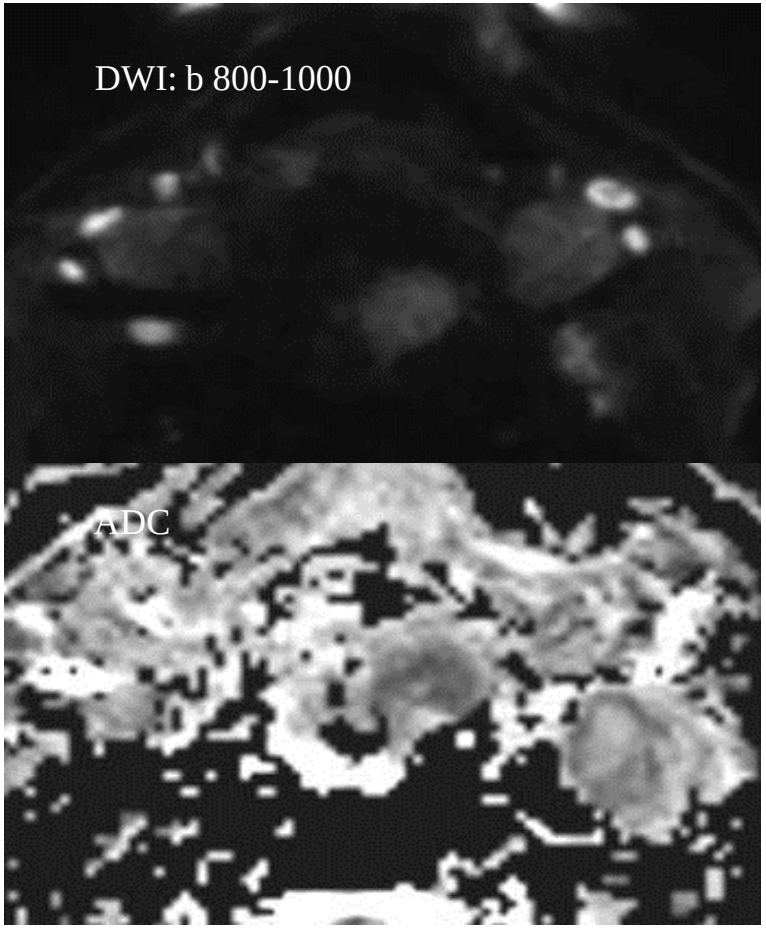
images after i.v. contrast dye early - late



morphology and DWI

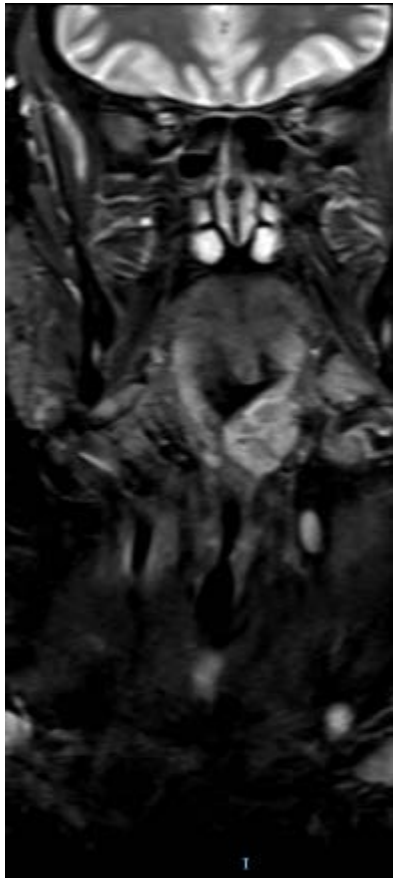
HPV + Mesopharynx ca

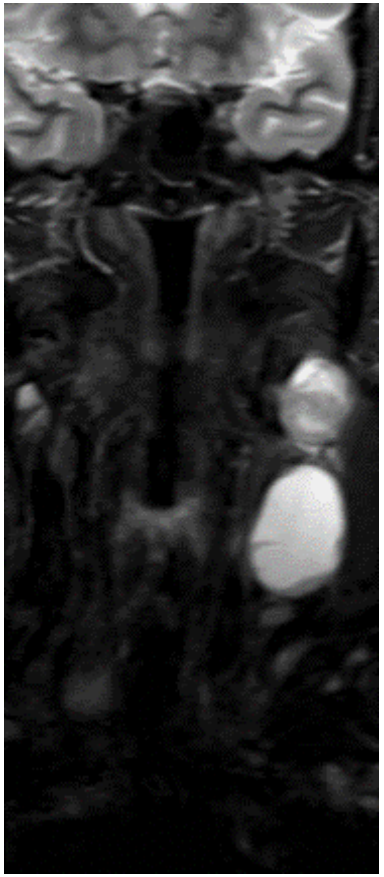




"pN value > 5 for oropharyngeal cancers was associated with decreased survival"
Roberts T et al. Cancer 2016; 122:1388–1397

HPV + oropharyngeal Karzinome





HPV+ und HPV- Ca = different tumour entities

histology:

HPV+ : non-keratizing, ∞ mitotic fig. + necrosis

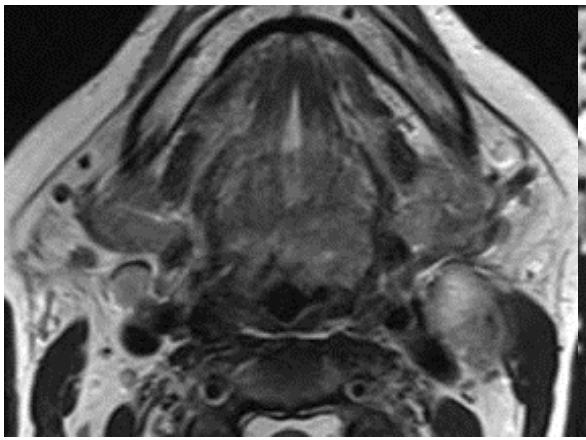
HPV - : large polygonal kertaninizing cells

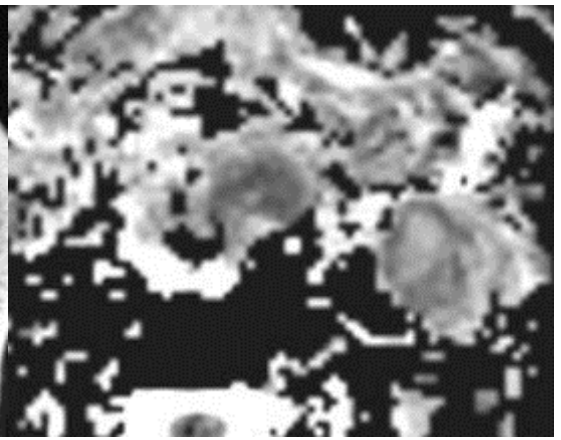
imaging:

HPV+ : exophytic, KD↑ + clearly delineated, frequent cystic metastatic lymph nodes (36%)

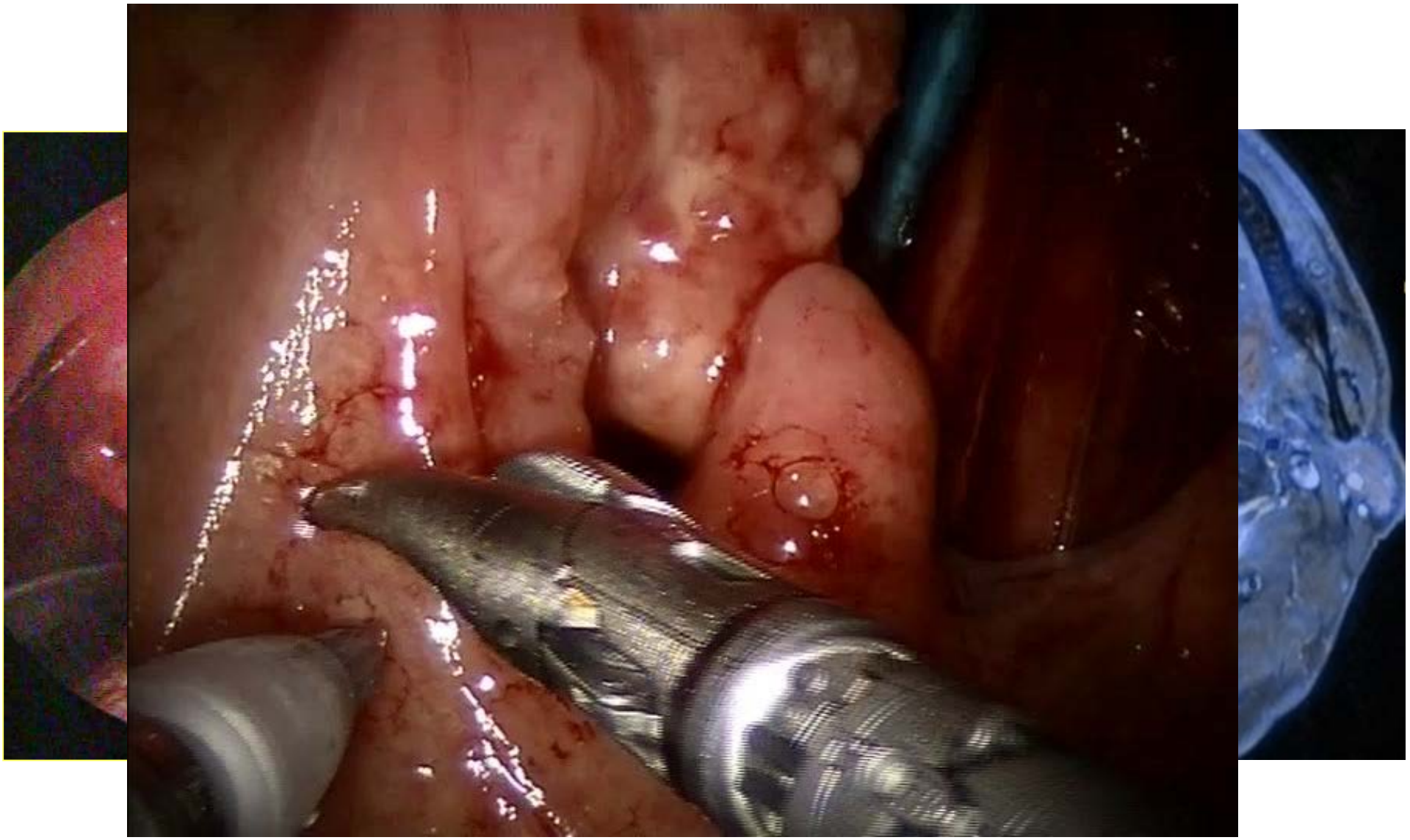
HPV - : infiltrating, KD +/-, blurred delineation, cystic ln rare (9%)

HPV+ : Tendenz zu ↓ ADC in solider Portion



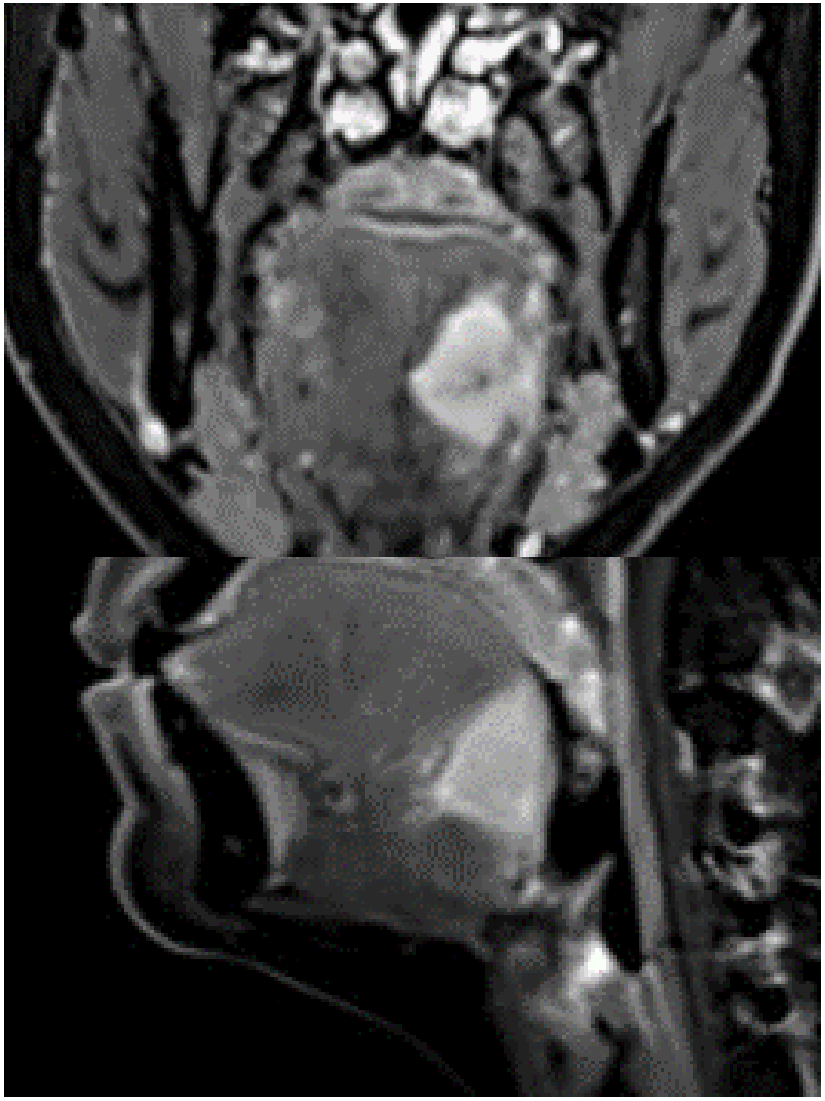


TORS of HPV+ tumour

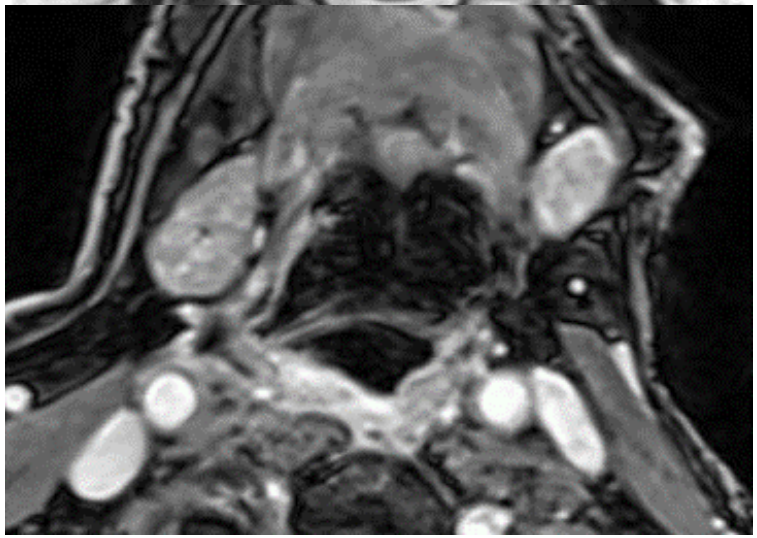


50y f smoking & drinking

p16 neg

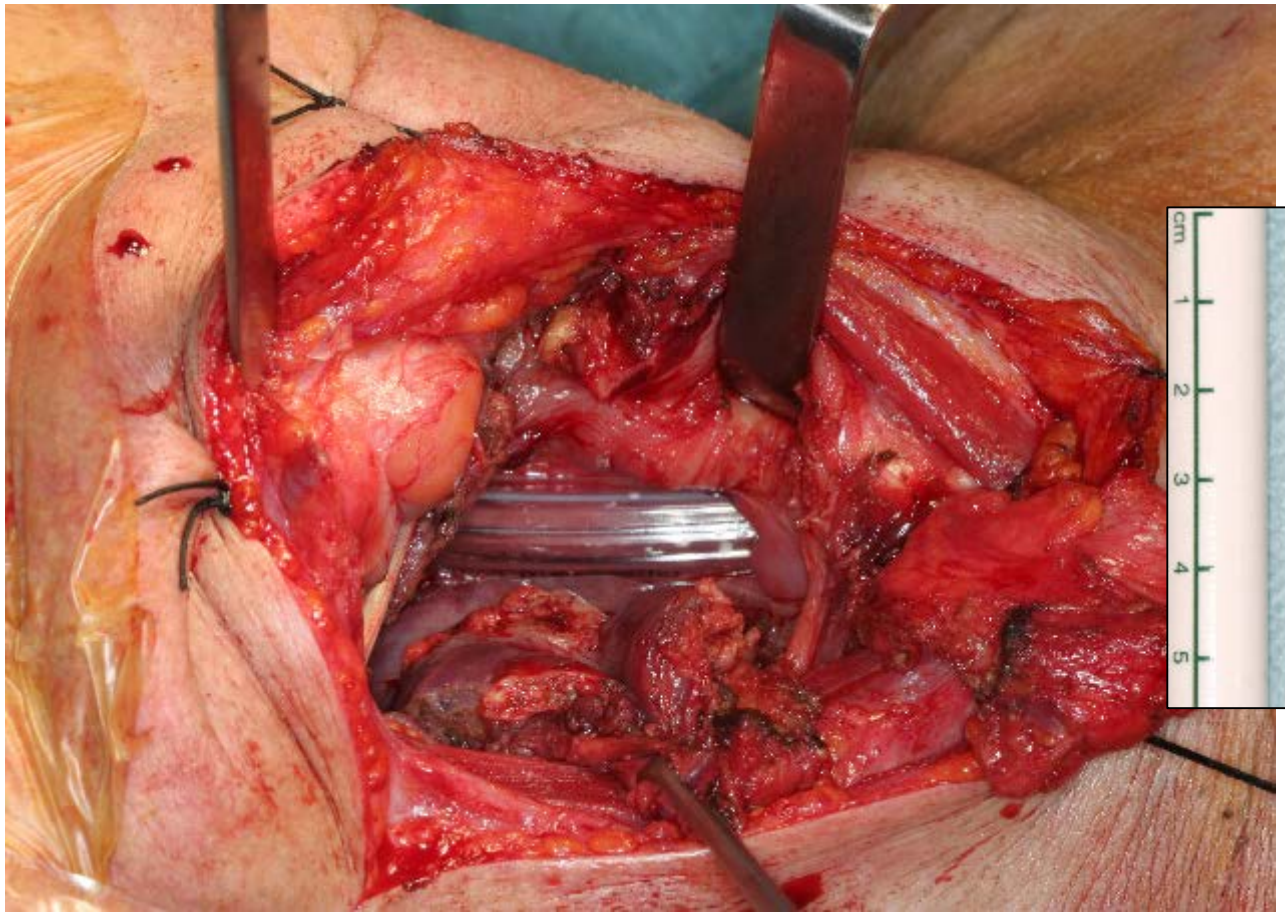


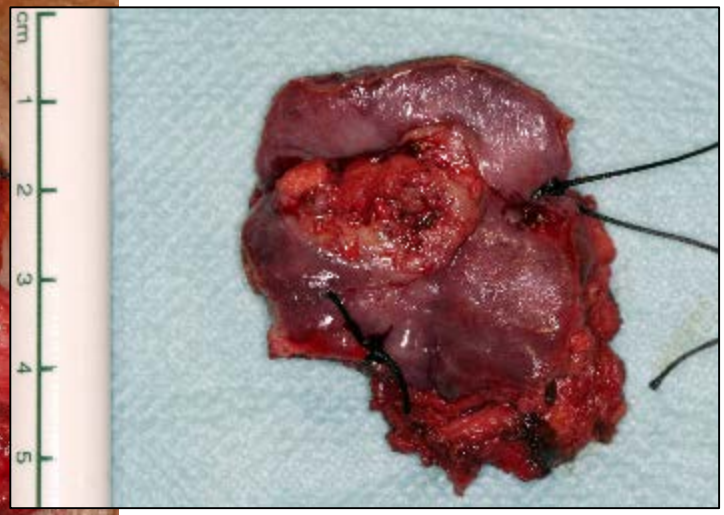
posterior pharyngeal wall



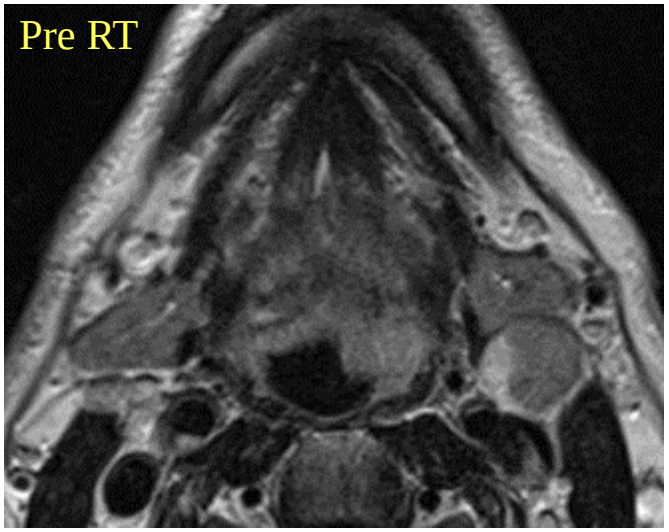
involvement of prevertebral fascia?

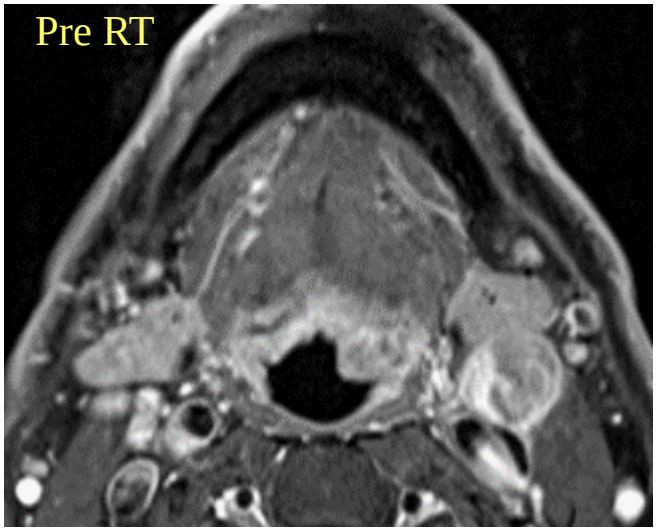
posterior pharyngeal wall

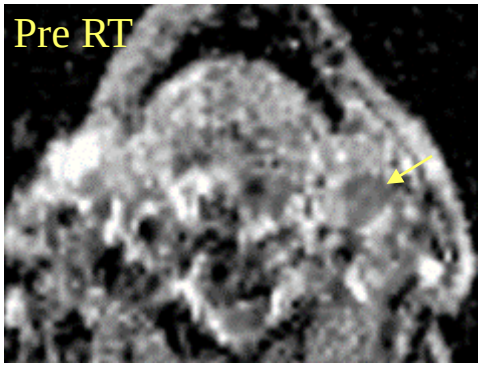


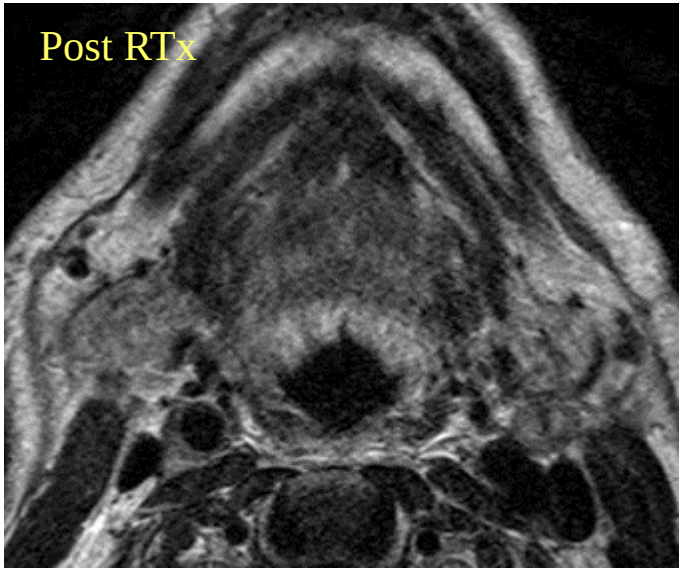


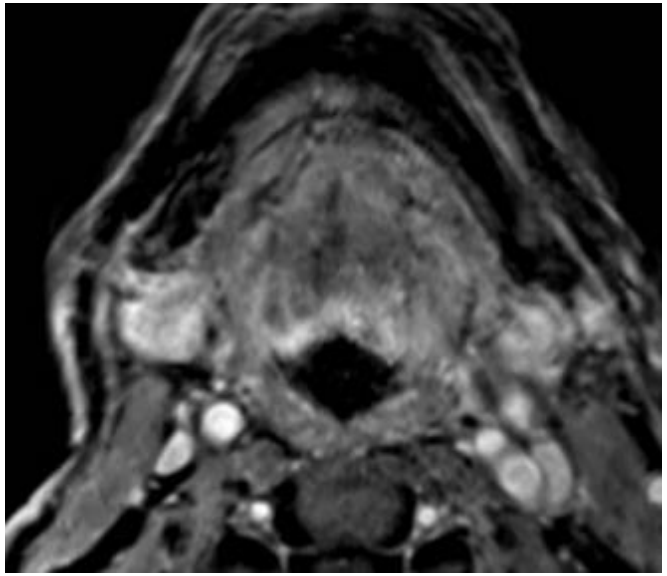
Primary – LN metastasis?

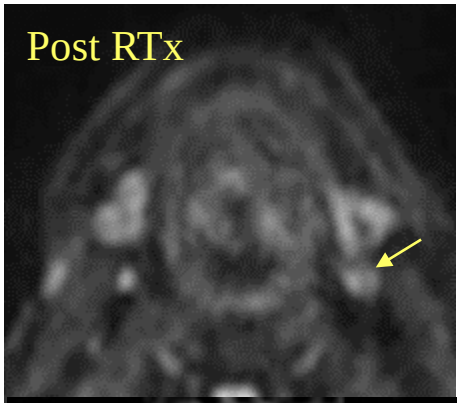


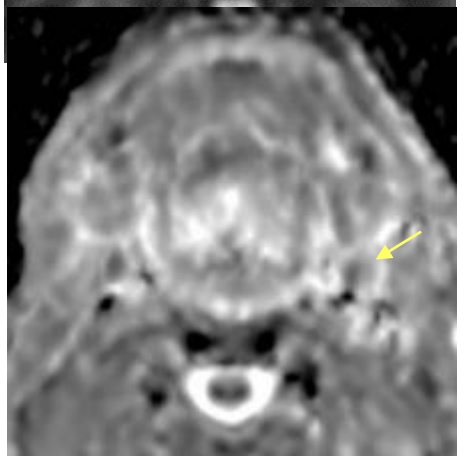












indication for salvage ND because of persisting nodal disease

nodal disease: MR + CT criteria

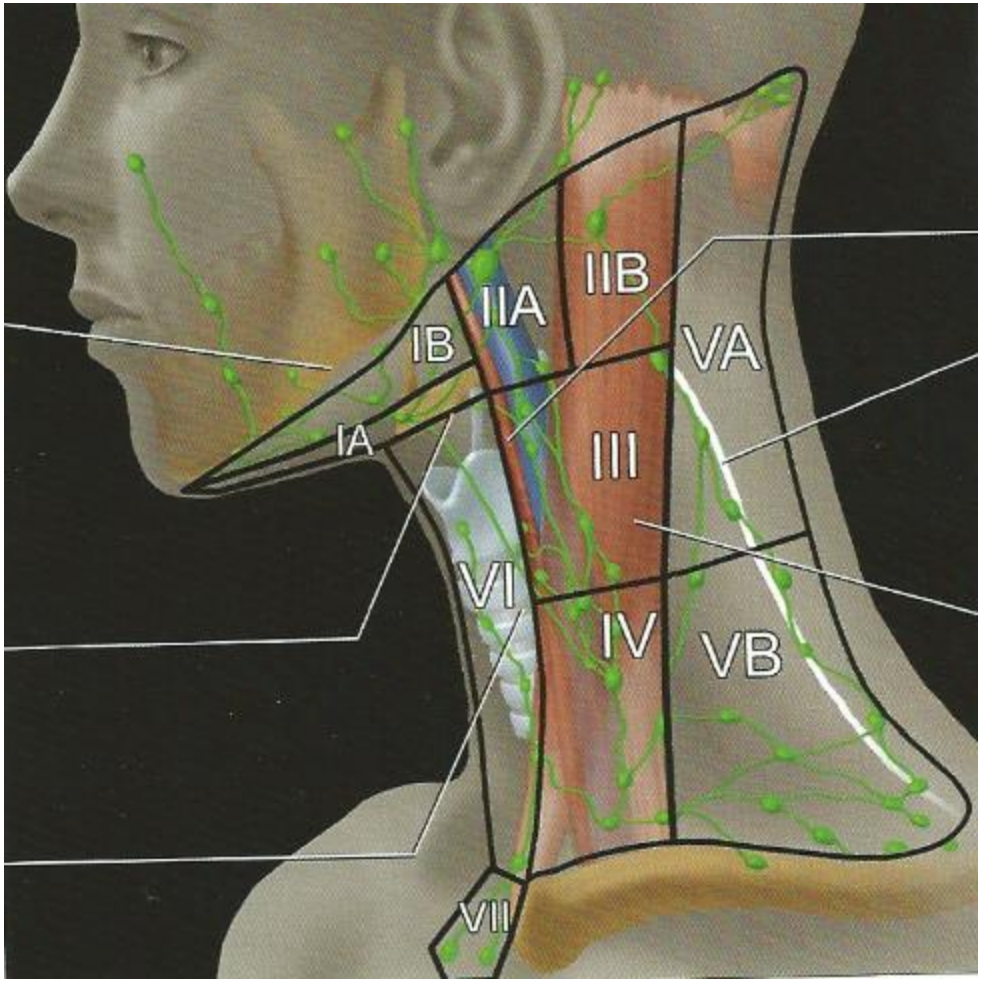
- > 10mm diameter of short axis
- > 8 mm transversal diameter of retropharyngeal nodes
- round shape (supporing criterion if size marginal)
- ln of all sizes with central hypodensity, hypointensity
- Conglomerate of 3 or more marginally enlarged ln
- diffuse delineation of surounding tissue around enlarged ln
- *„size is the least reliable among the criteria listed“*

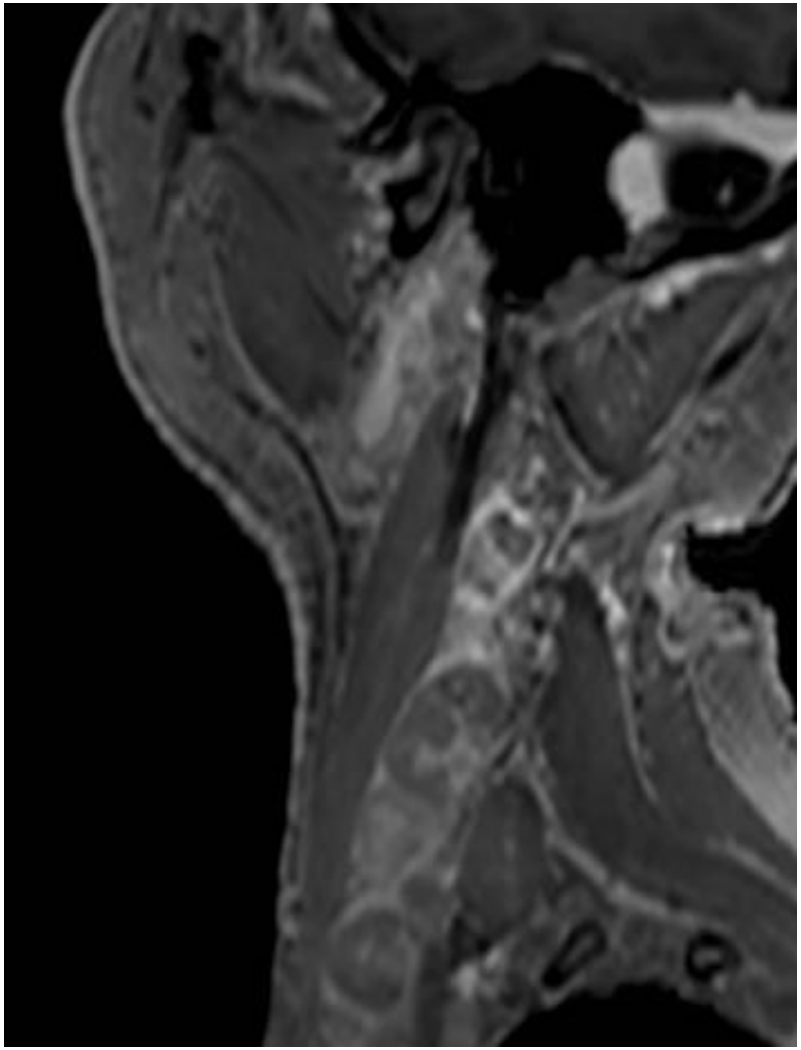
Som PM. Detection of metastasis in cervical lymph nodes: CT and MR criteria and differential diagnosis. *AJR Am J Roentgenol* 1992; 58:961–969

LN Staging

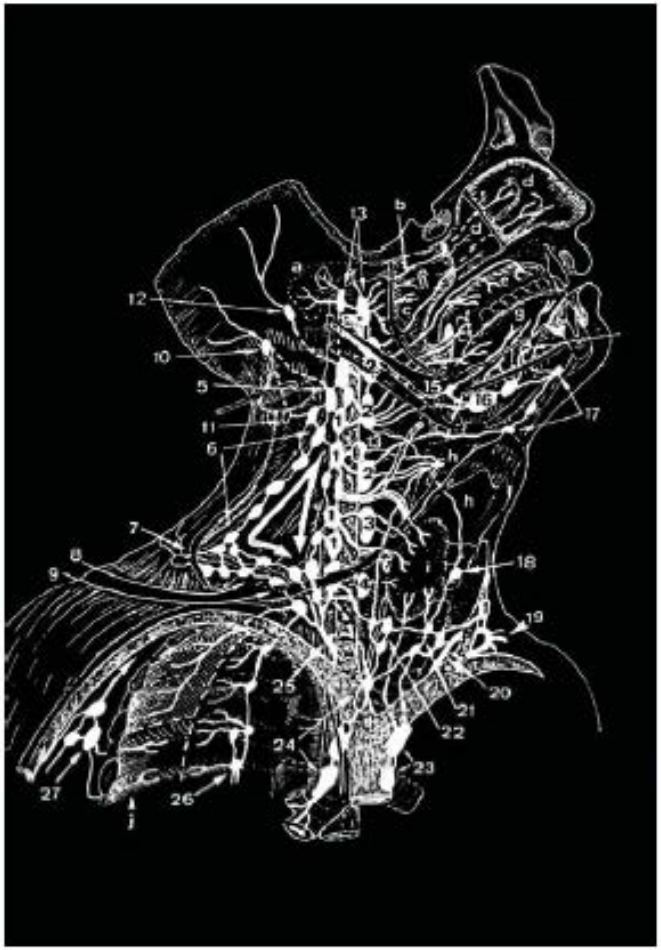
- **N0 no regional ln metastasis**
- **N1 singular ipsilateral LN ≤ 3cm**
- **N2a singular ipsilateral LN > 3cm < 6cm**
- **N2b multiple ipsilateral LN < 6cm**
- **N2c bilateral or kontralateral LN < 6cm**
- **N3 LN Metastasis > 6cm**

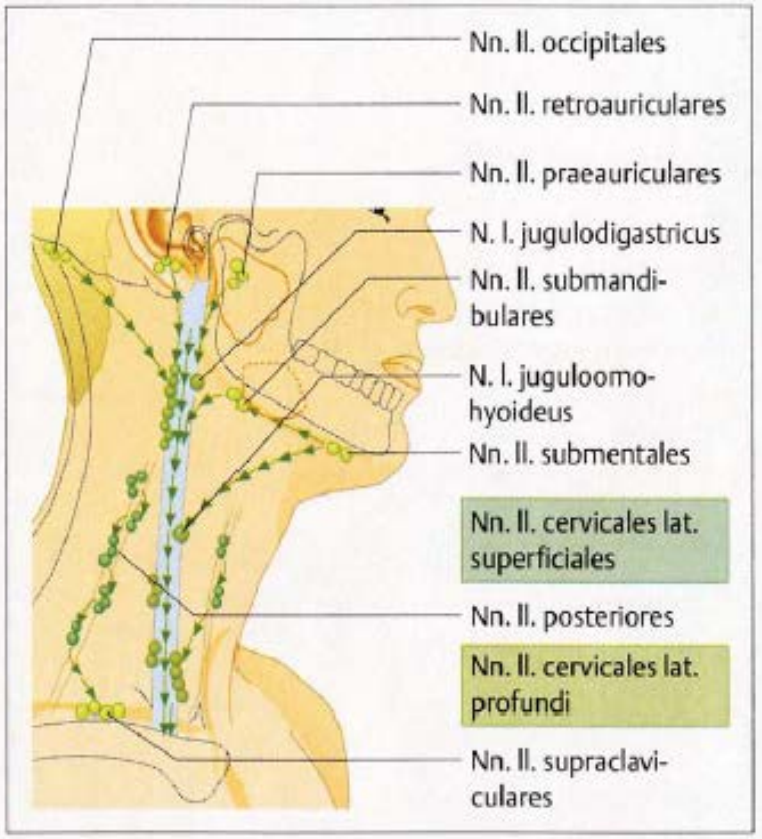
LN levels

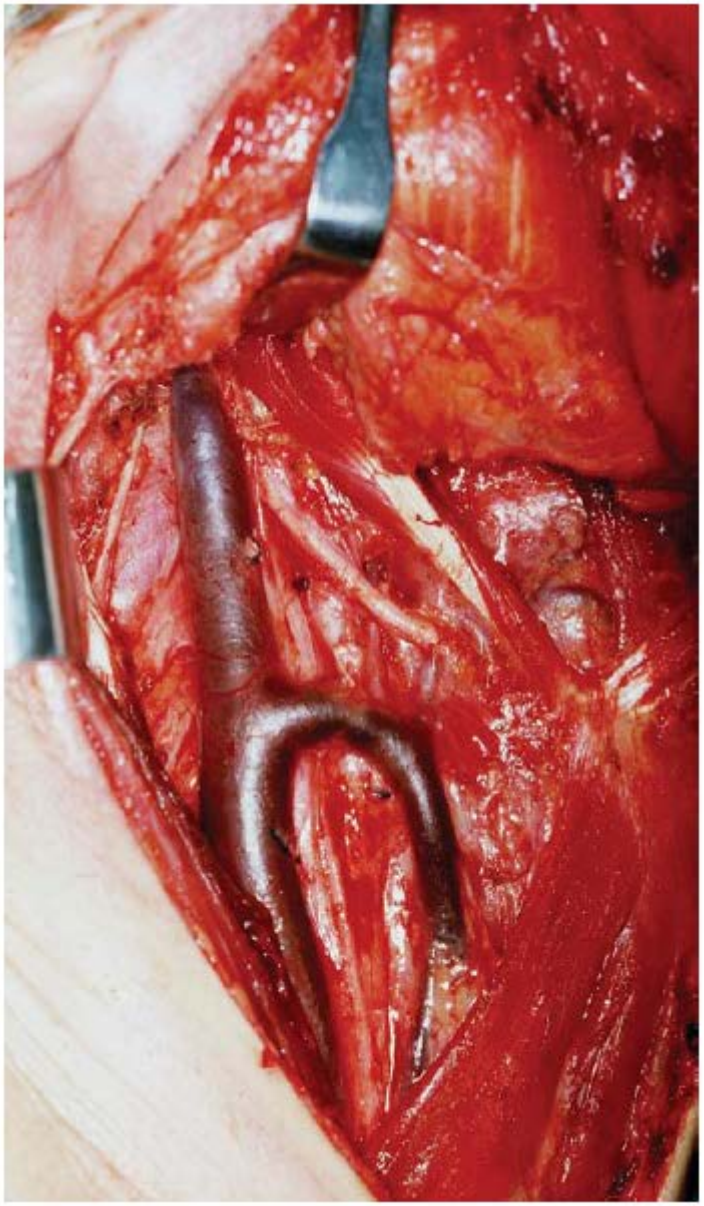


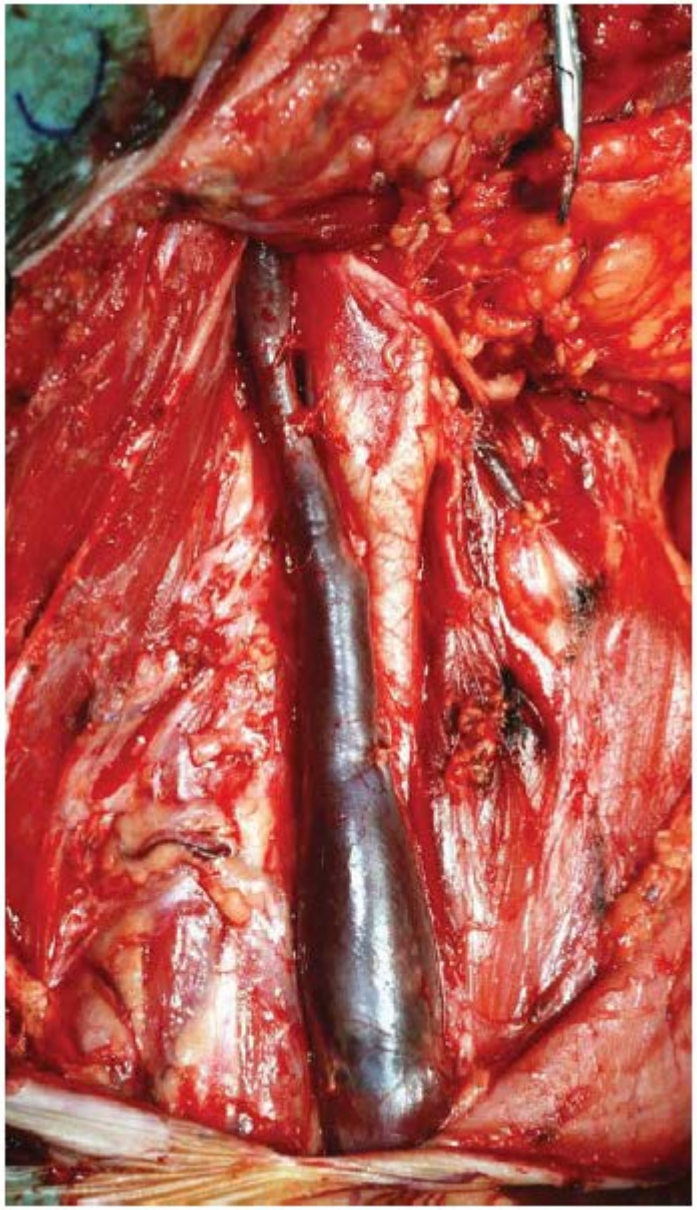


LK levels

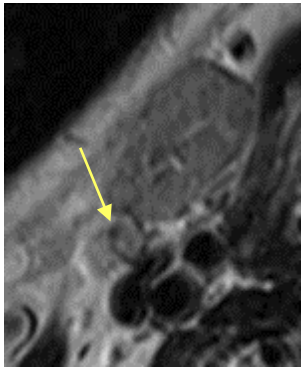


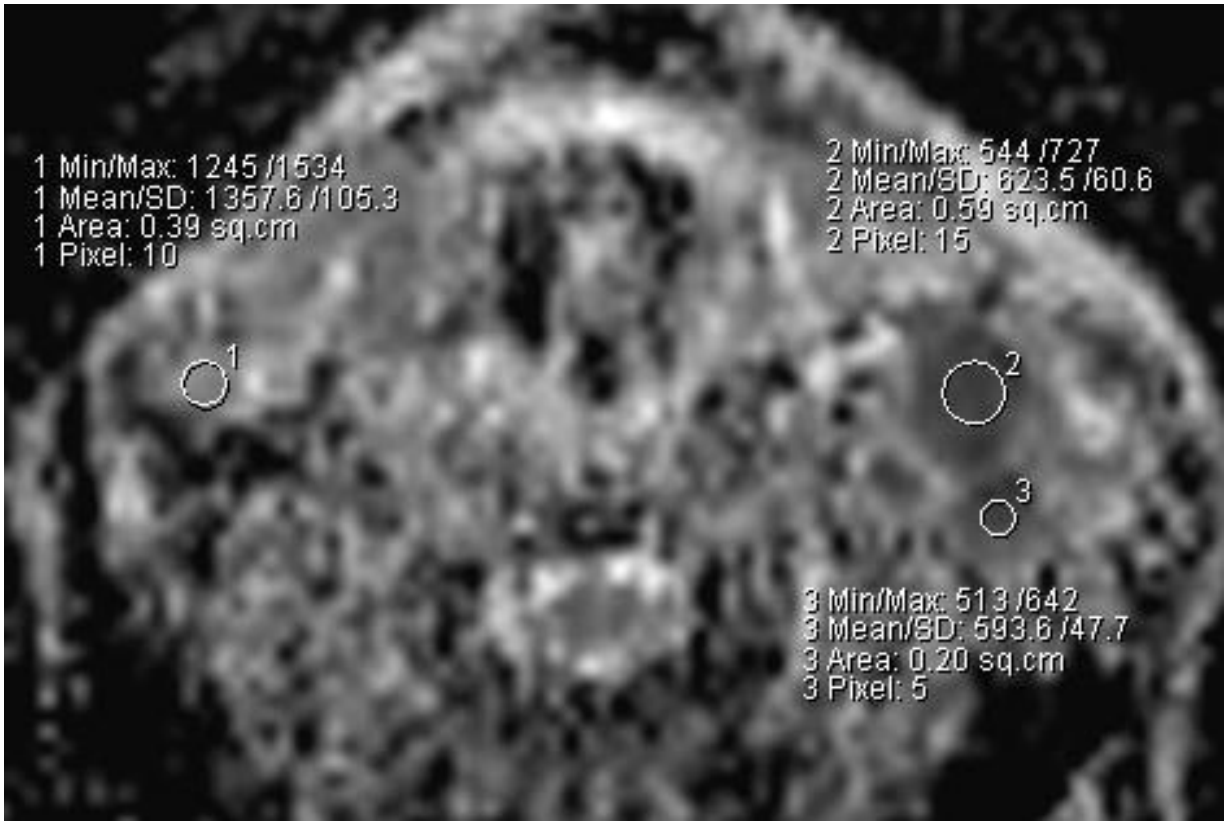

Nn. ll. occipitales
Nn. ll. retroauriculares
Nn. ll. praeauriculares
N. l. jugulodigastricus
Nn. ll. submandi-bulares
N. l. juguloomo-hyoideus
Nn. ll. submentales
Nn. ll. cervicales lat. superficiales
Nn. ll. posteriores
Nn. ll. cervicales lat. profundi
Nn. ll. supraclavi-culares

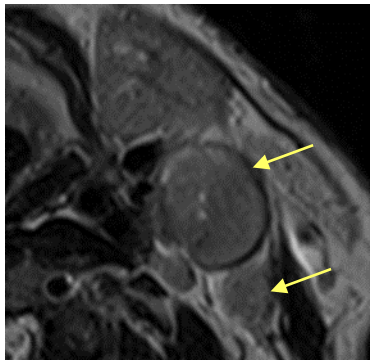




quantifing ADC values

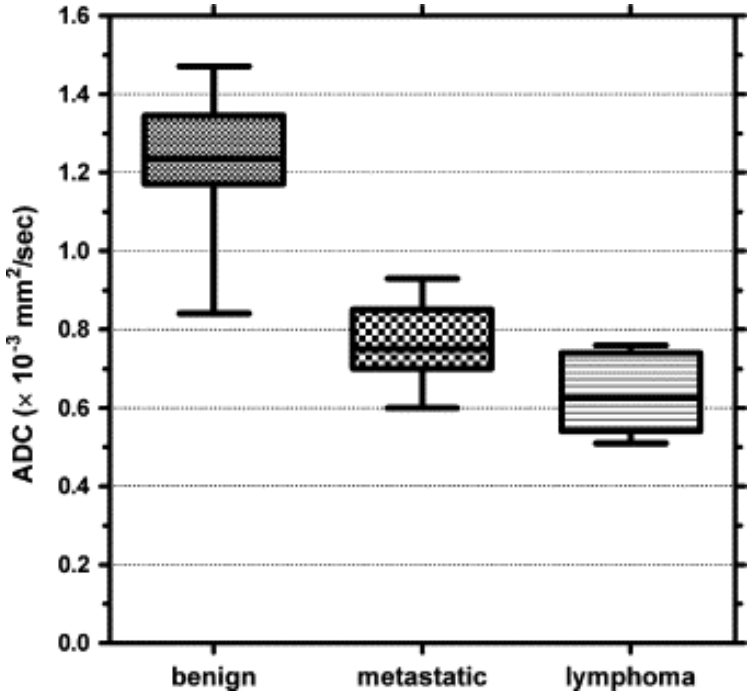






the mean value of benign nodes 1.448 × 10^{-3} mm^2/s;
the mean ADC value of malignant nodes 0.85 × 10^{-3} mm^2/s,
best threshold value was $1.03\times10^{-3} mm^2/s$, (sensitivity 100%, specificity of 92.9%).
Perrone A et al. European Journal of Radiology 2011; 77: 281-286

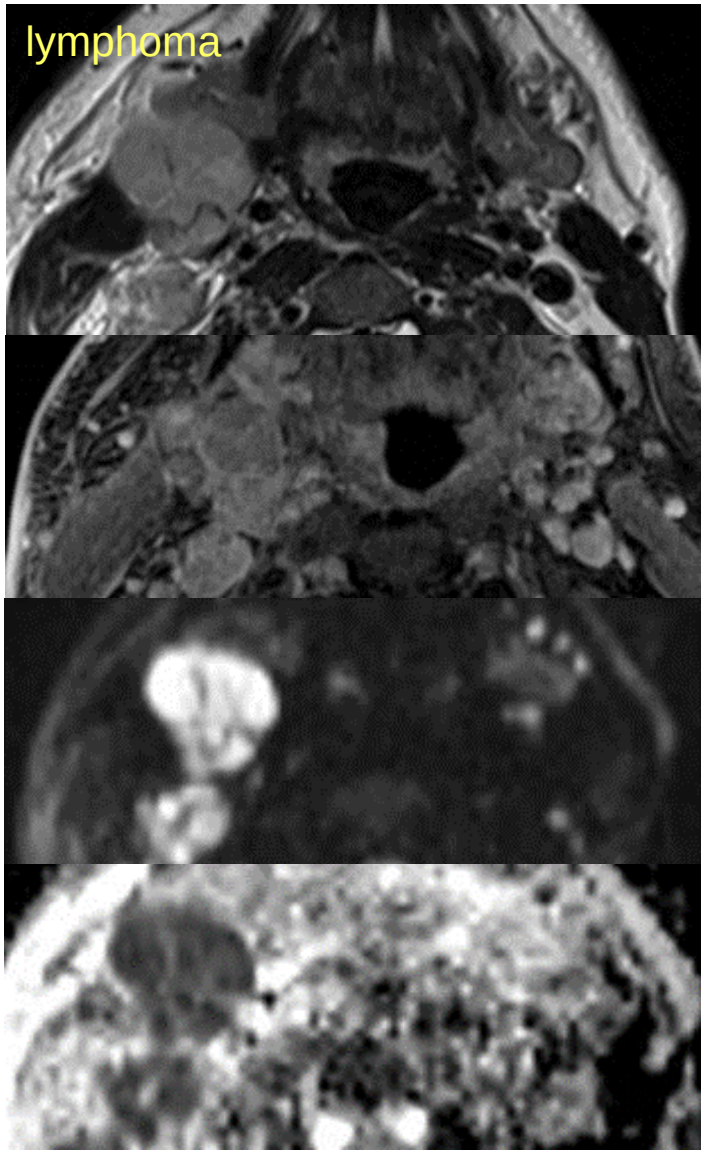
ADC threshold value for differentiating between benign and malignant cervical ln 1.02×10^{-3} mm^2/s.

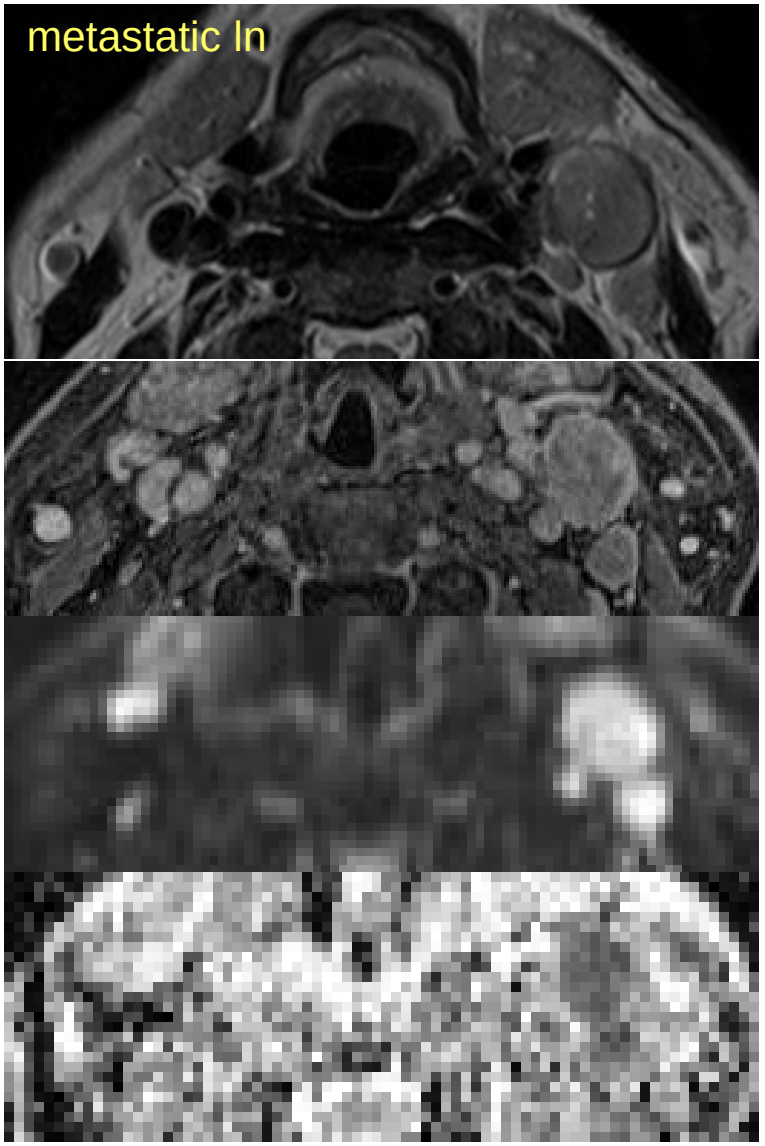


sensitivity	100%,
specificity	87.0%,
accuracy	94.3%,
PPV	90.9%
NPV	100%.

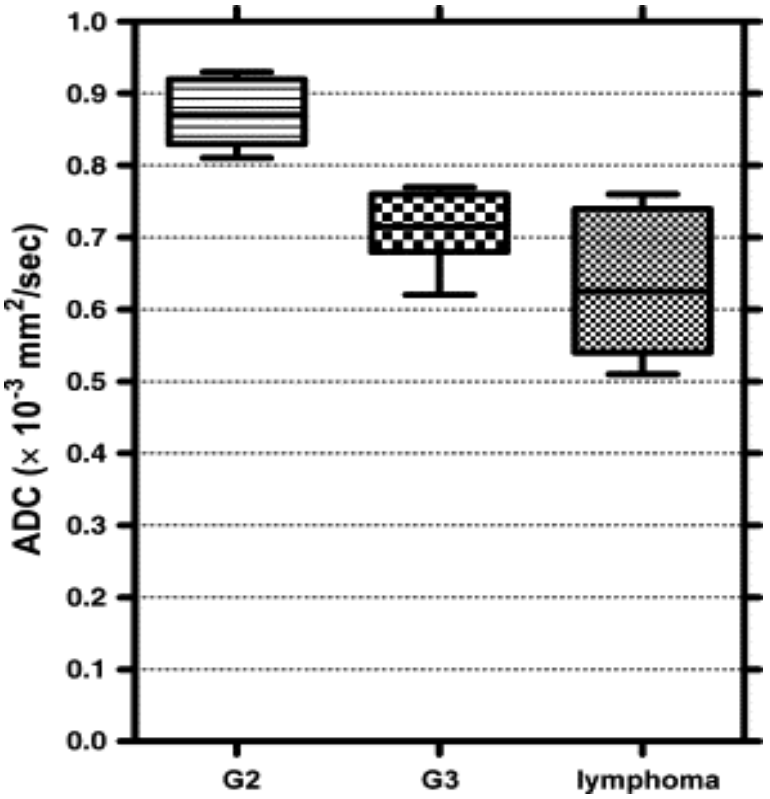
Holzapfel K et al. Value of diffusion-weighted MR imaging in the differentiation between benign and malignant cervical lymph nodes Eur J Radiol 2009; 72:381-387

ADC < lymphoma vs metastatic ln





ADC ~ histologic grading of metastatic ln



"ADC values of metastatic moderately (G2) & poorly (G3) differentiated carcinoma and lymphomatous nodes differences of ADC values between the three groups were statistically significant ($P < 0.05$) and ($P < 0.05$)".

Holzapfel K et al. Value of diffusion-weighted MR imaging in the differentiation between benign and malignant cervical lymph nodes Eur J Radiol 2009; 72:381-387

ADC values under treatment

tumour

responders → ADC (<0.79) vs non-responders > 0.79) pre Tx

[1]Δ ADC > 14% SE 88%, SP 91% 2w Ch-RT

[1]Δ ADC > 25% SE 100%, SP 91% 4w Ch-RT

[2]Δ ADC > 35% SE 45%, SP 100% 6 w post Tx

[3]ADC > 1.3 x × 10^{-3} mm^2/s SE 94%, SP95% end CH-RT

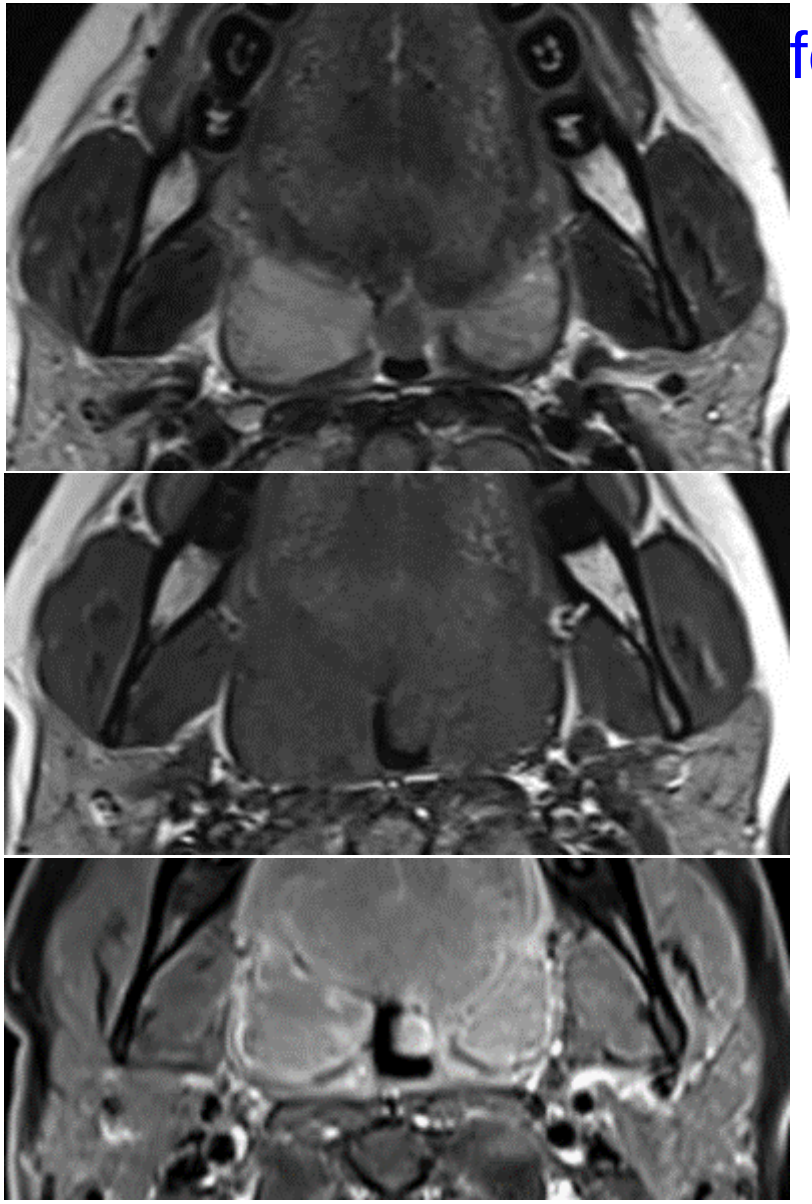
lymph nodes

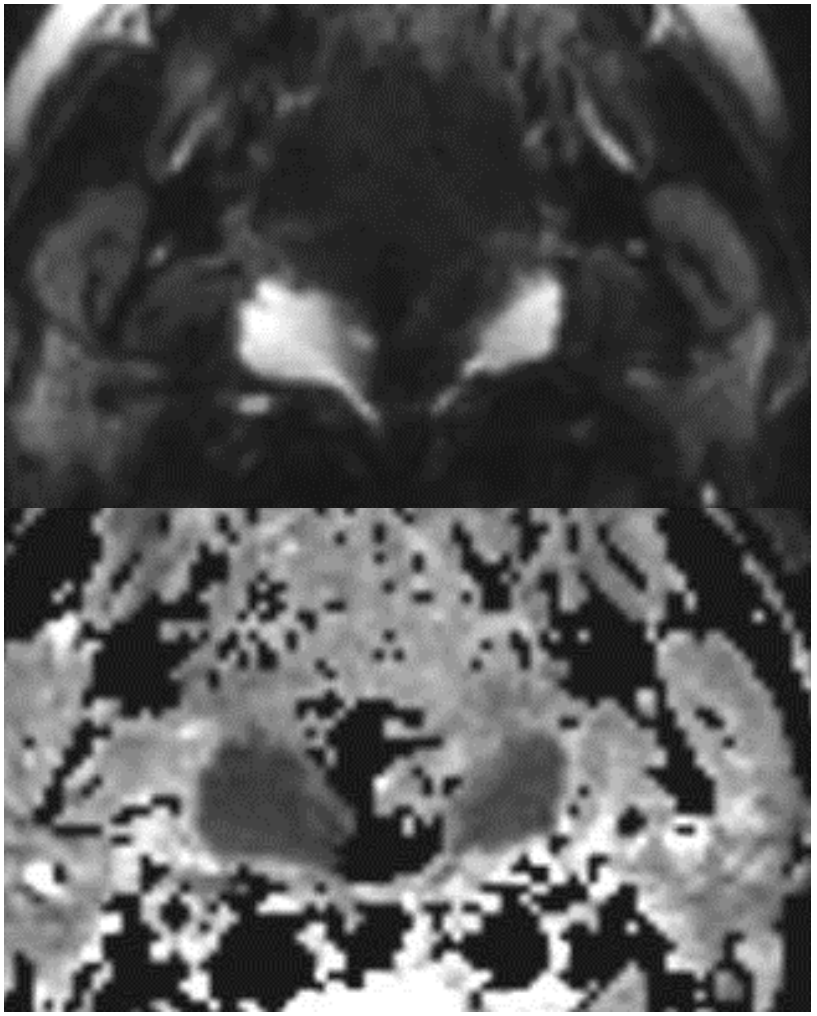
[1]Δ ADC > 14% SE 80%, SP 89% 2w Ch-RT

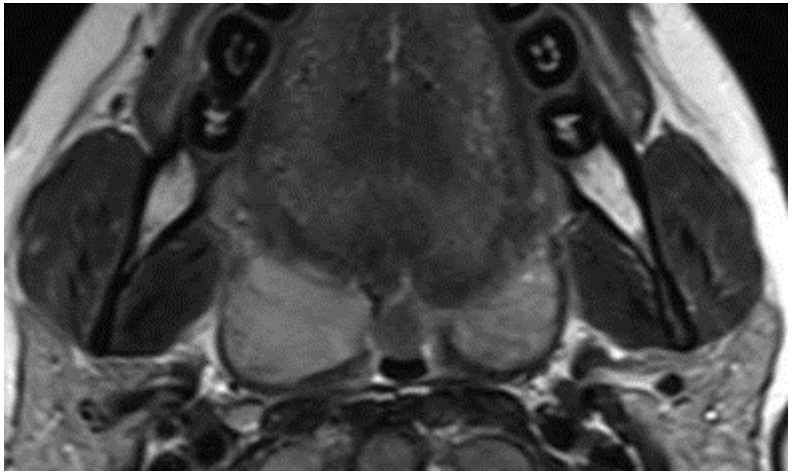
[1]Δ ADC > 19% SE 80%, SP 96% 4 w Ch-RT

[1] Vandecaveye 2010
[2] King 2010
[3] Vandecaveye 2007

35y, w , ø risk factors,
foreign body feeling, enlarged tonsil







DCE Perfusion

information regarding micro-vascular structure of neoplasia analyzing kinetics of iv contrast dye bolus

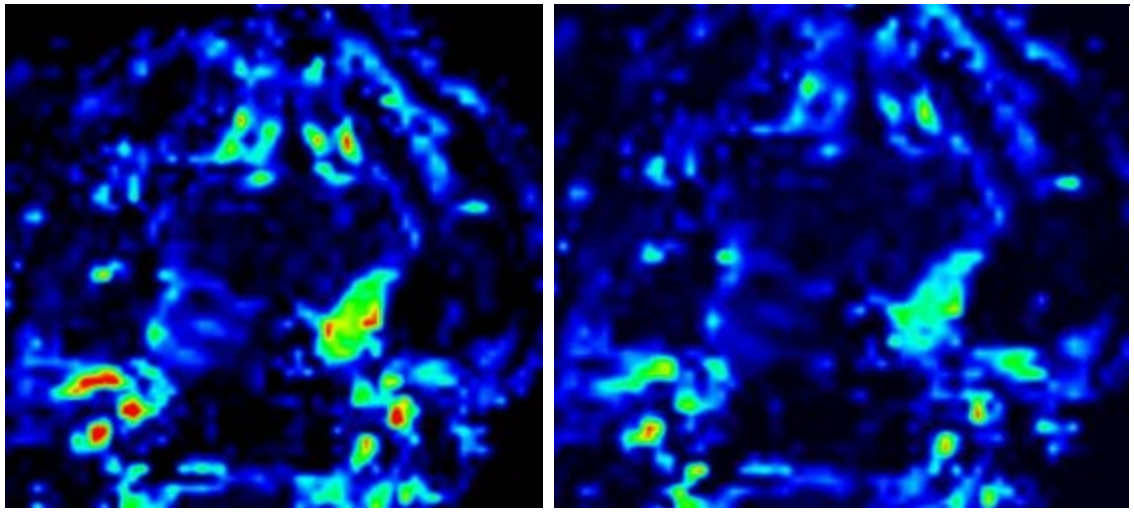
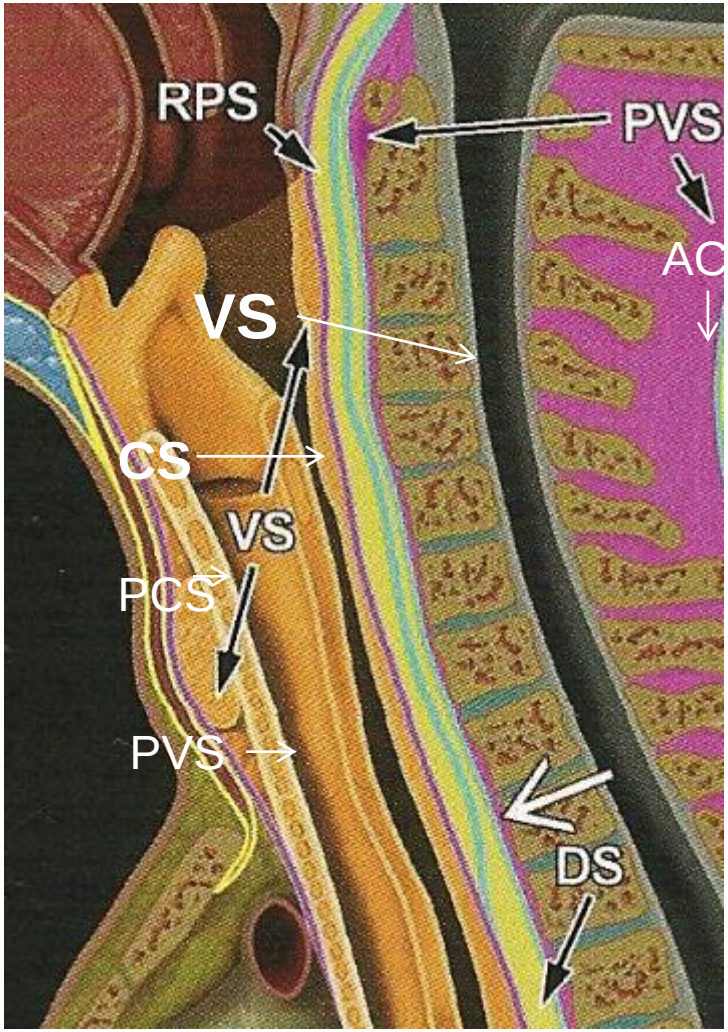


Table 3.
Mean and standard deviation of the DCE parameters for UD, SCC a

	UD	SCC	Lymphoma
Tofts	28	28	8
k_{trans} (1/min)	1.26 ± 0.61	0.78 ± 0.47	0.59 ± 0.18
v_e	0.65 ± 0.16	0.64 ± 0.13	0.54 ± 0.17
v_p	0.11 ± 0.12	0.08 ± 0.06	0.07 ± 0.03
Semi-quantitative			
AUC60 (norm. unit)	0.31 ± 0.11	0.23 ± 0.10	0.21 ± 0.05
AUC90 (norm. unit)	0.74 ± 0.28	0.54 ± 0.21	0.50 ± 0.09

Lee FK-H et al. Dynamic contrast enhancement magnetic resonance imaging (DCE-MRI) for differential diagnosis in head and neck cancers. Eur J radiology 2012; 81:784–788

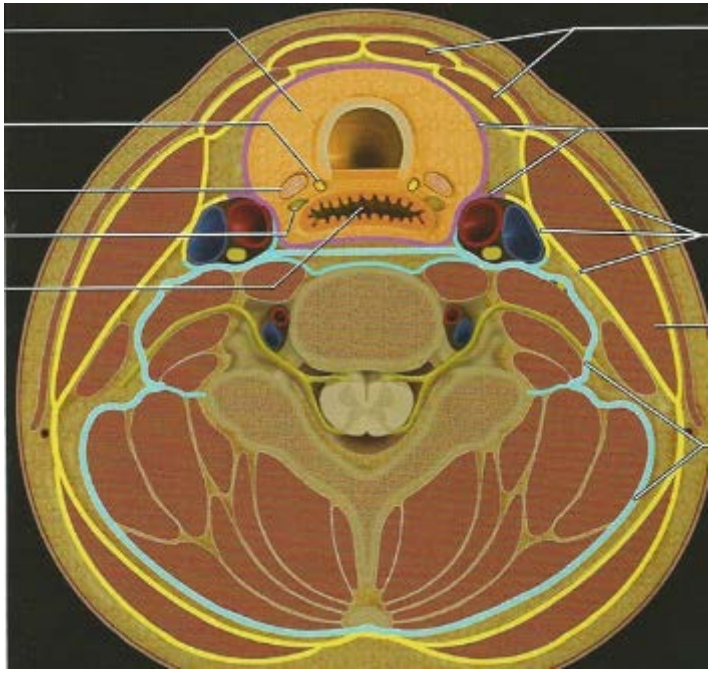


visceral space

hyoid → mediastinum

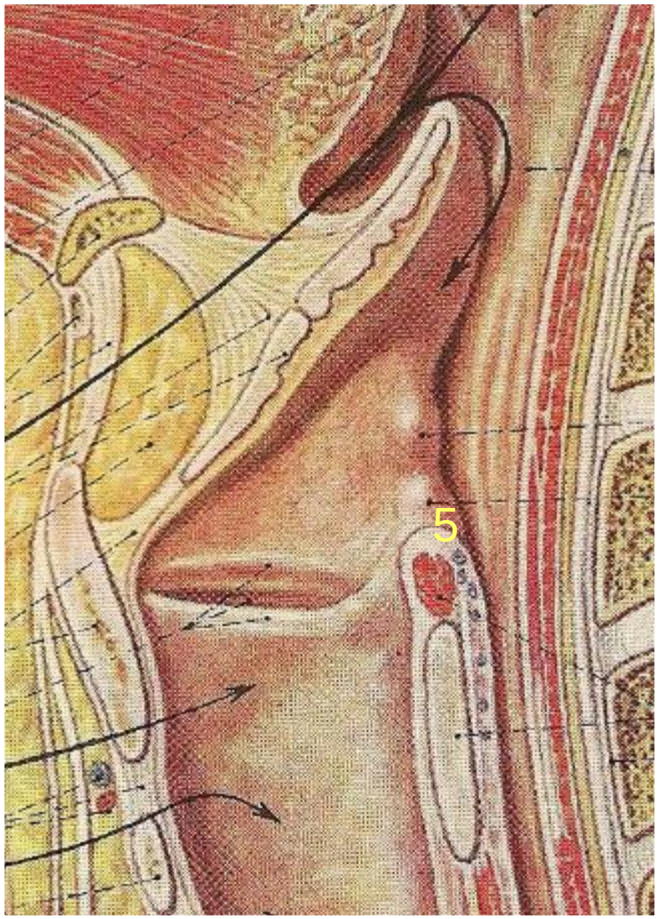
content:

larynx
trachea
hypopharynx
cervical esophagus
(para-)thyroid(s)
recurrent laryngeal n.
Ln (pre- & paratracheal)



visceral space – middle sheet
anterior cervical space
carotid space
retropharyngeal space
«danger space»

subdivision of the larynx

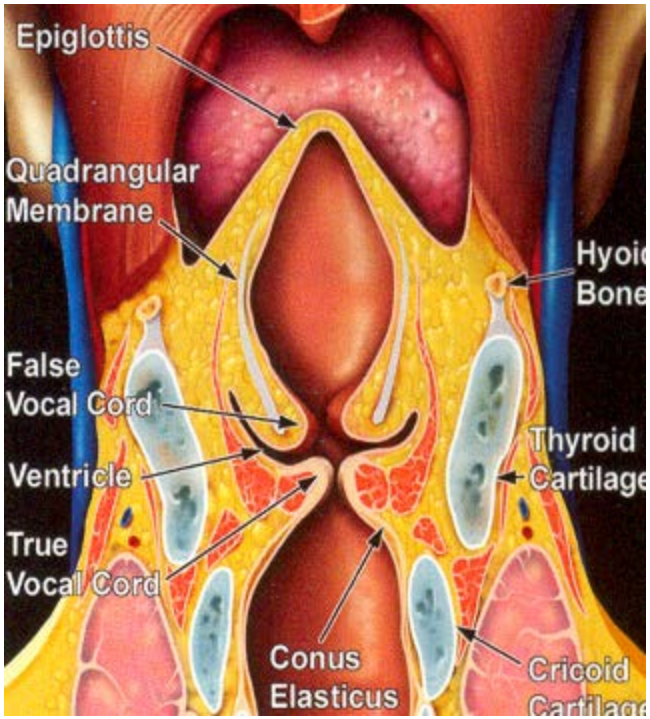


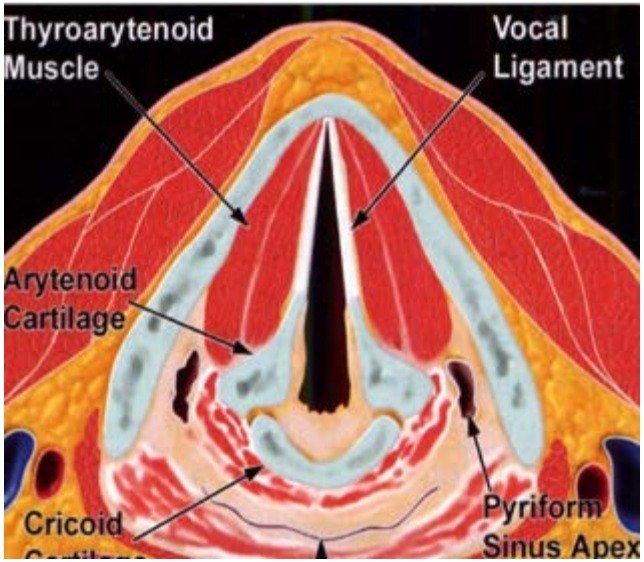
supraglottic

glottic

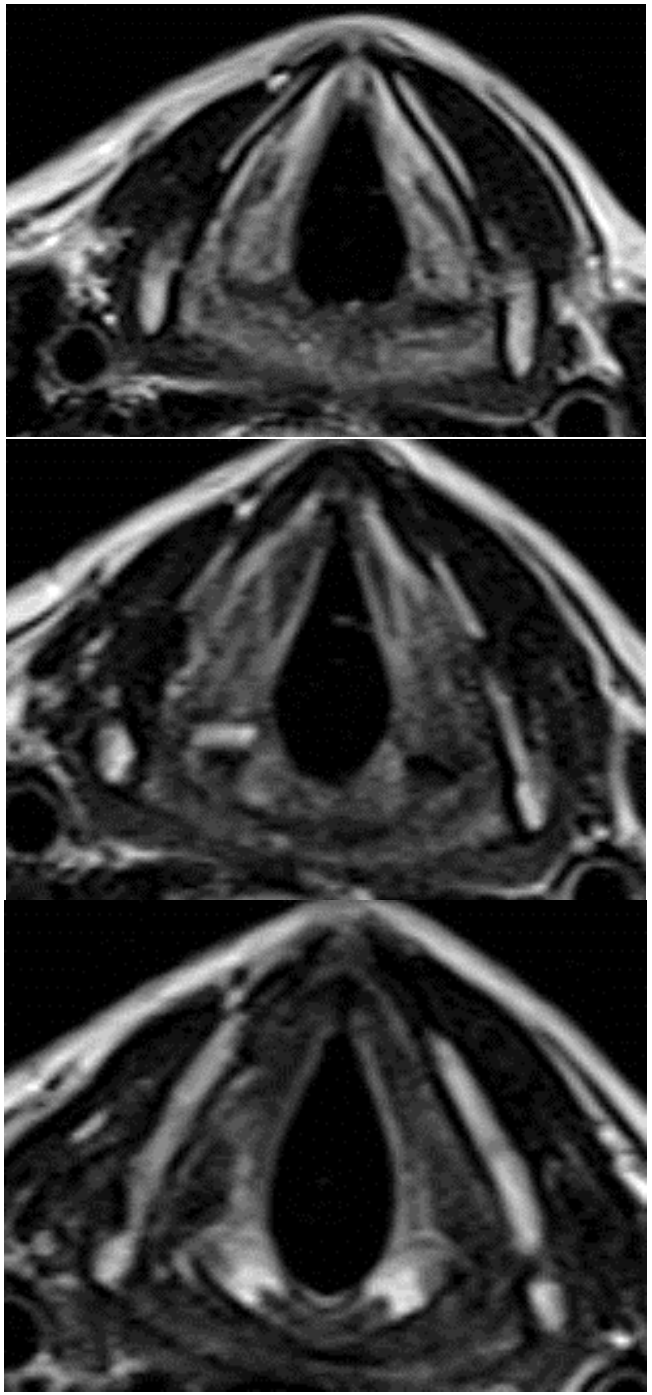
subglottic

transverse + oblique arytenoid mm.





m. vocalis = medial fibers of thyroarytenoid m.



T2 space
1.2mm

laryngeal cancer

90% SCC

- supraglottic 30% → pre-, paraglottic ?

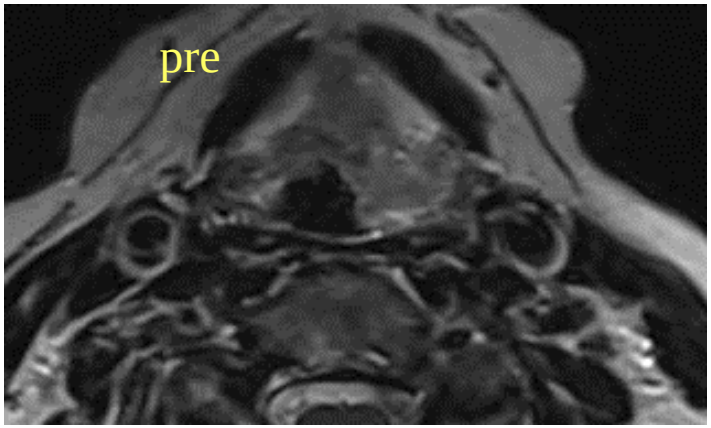
  ln 38-50% (20-25% bilat)

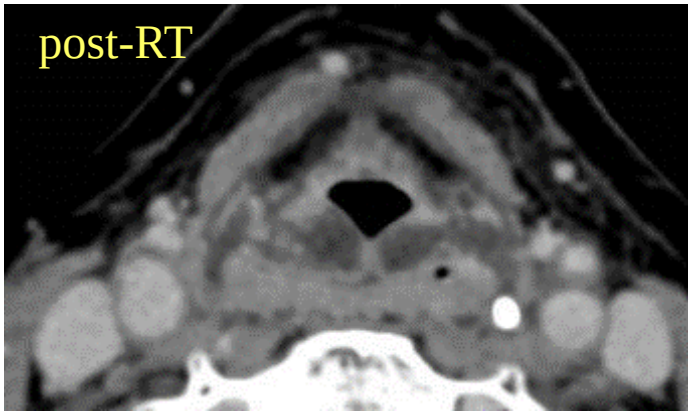
- glottic 65% → ant. commisure, contralateral vocal cord
  para-/subglottic extension, laryngeal skeletton & involvement of extralaryngeal space ?

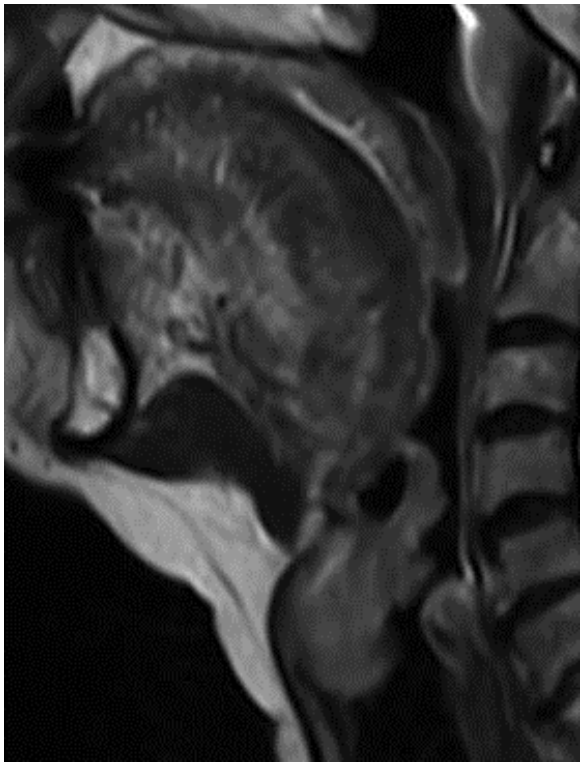
  ln 10-25% over all / T2 5%, T3 18%,T4 32%

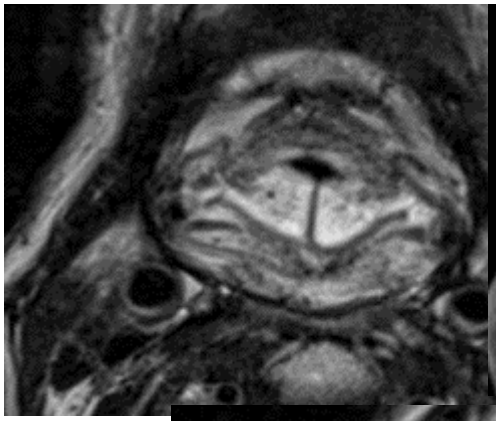
- subglottic 2- 5%
  → trachea (thyroid, esophagus) ?

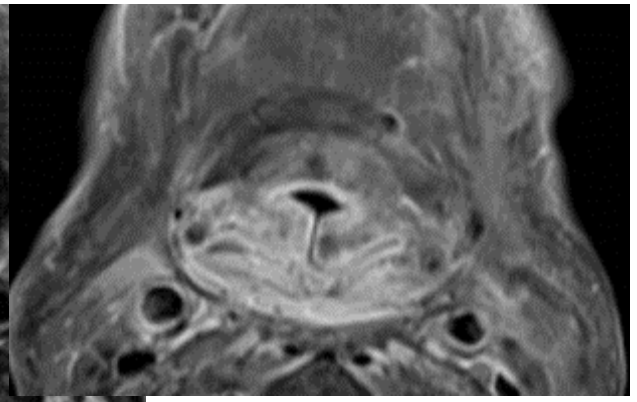
supraglottic laryngal-cancer
post-RT edema

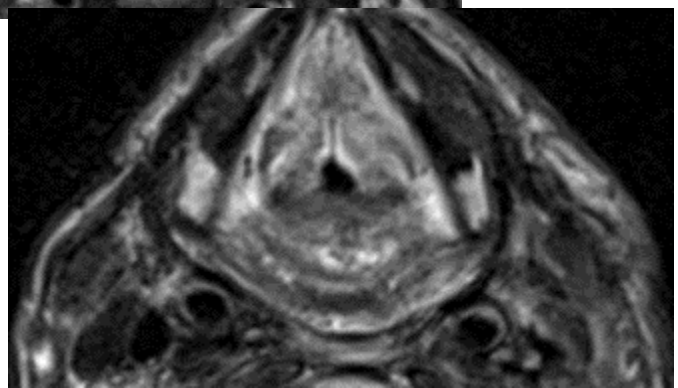












T classification glottic cancer

T1: tumour confined to vocal cord(s) (± ant. or post. commmissure) mobility not impaired
T1a: tumour confined to one vocal cord
T1b: tumor affects both vocal cords

T2: extention to supraglottic &/or subglottic space, &/or impaired vocal cord mobility

T3: tumour confined to the larynx, paraglottic &/or infiltration of the inner layer of thyroid cartilage, fixed vocal cord

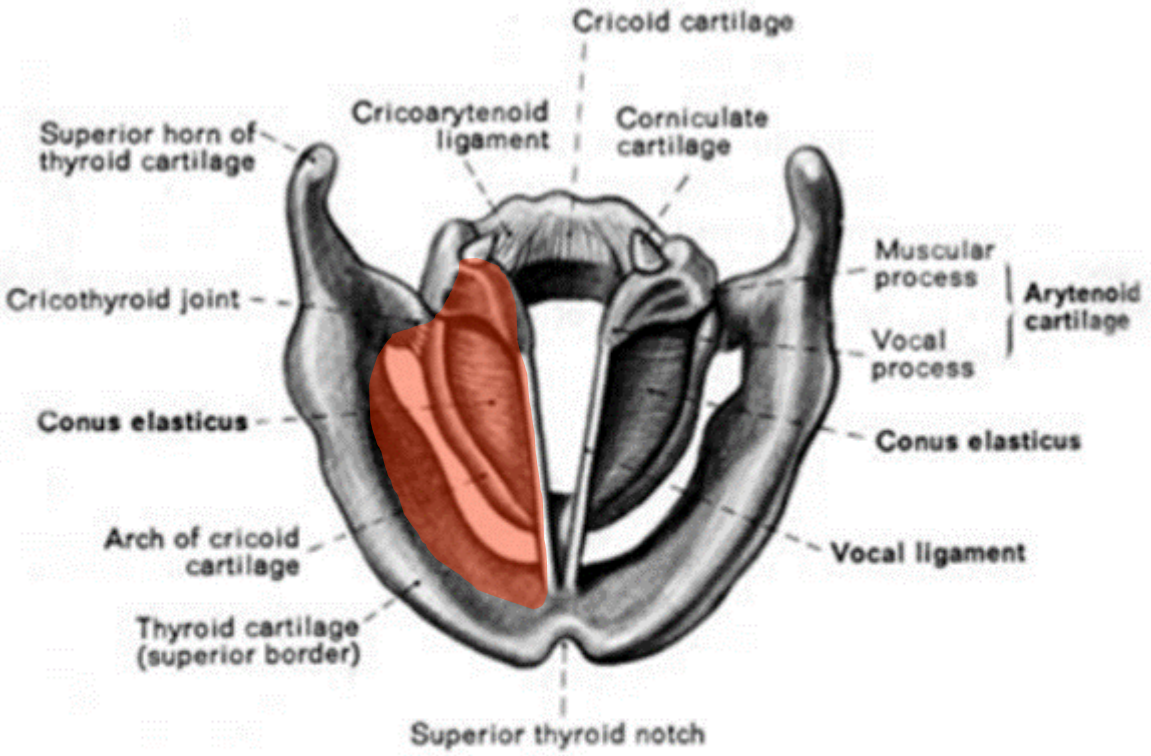
T4: tumour breaches thyroid cartilage, &/or extralaryngeal extention (e.g. trachea, thyroid, pharynx)

quadrangular membrane
«towel of connective tissue»
epiglottis to arytaenoid cartilages

Conus elasticus

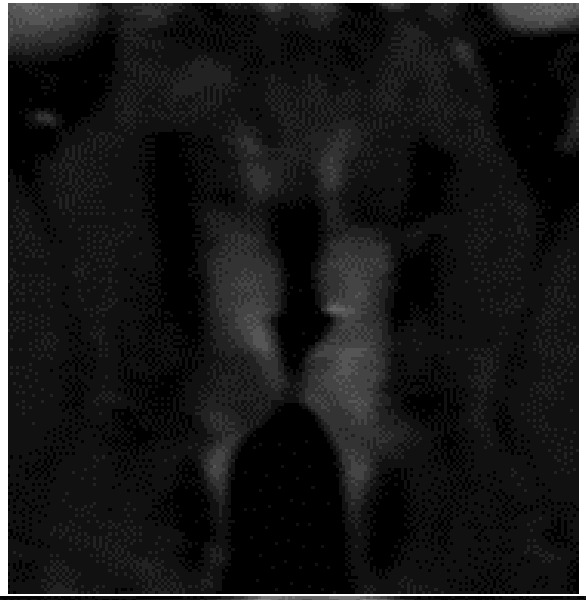
Broyle's Ligament: no peri-chondrium

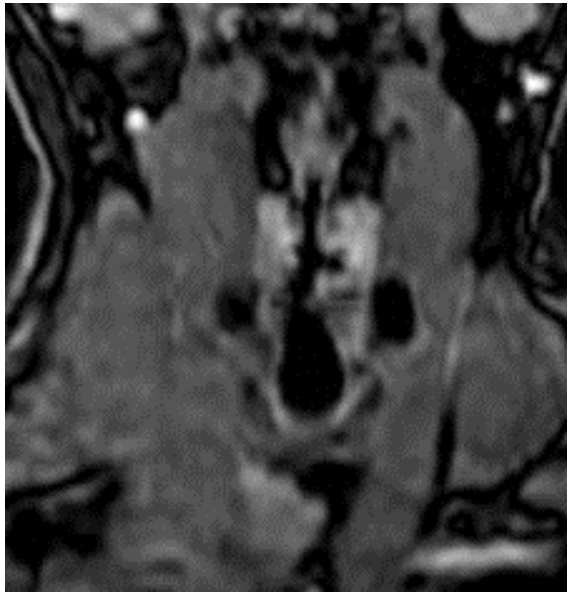
Hyoepiglottic ligament: «roof»
Of the para- & preepiglottic space

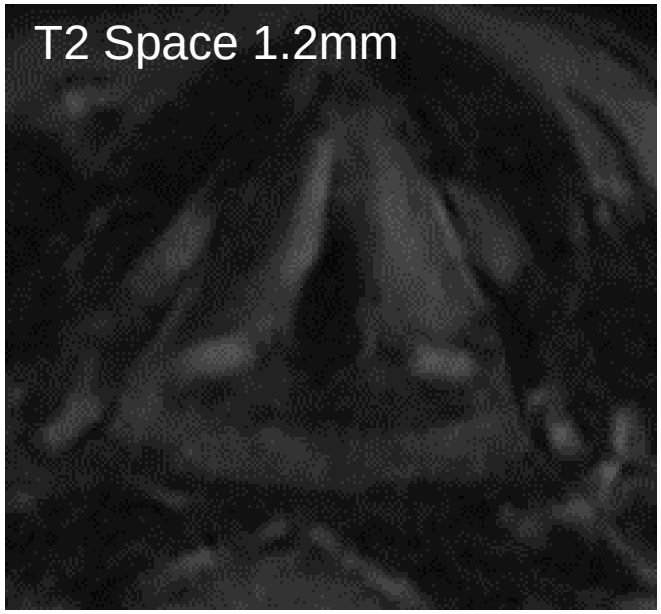


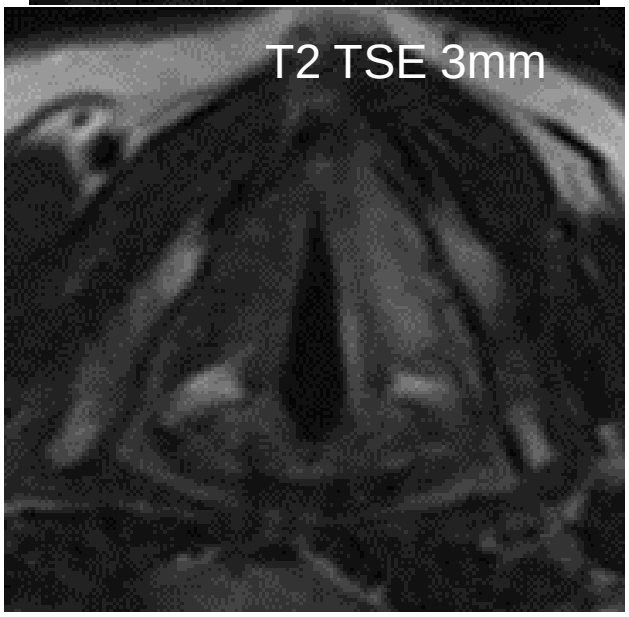
glottic Ca with paraglottic extension (T3)

supra-subglottic ?
paraglottic ± cartilage ?



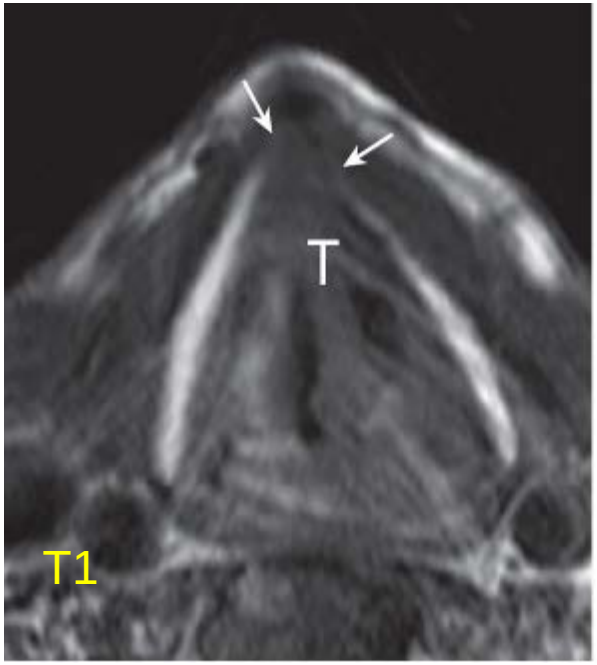


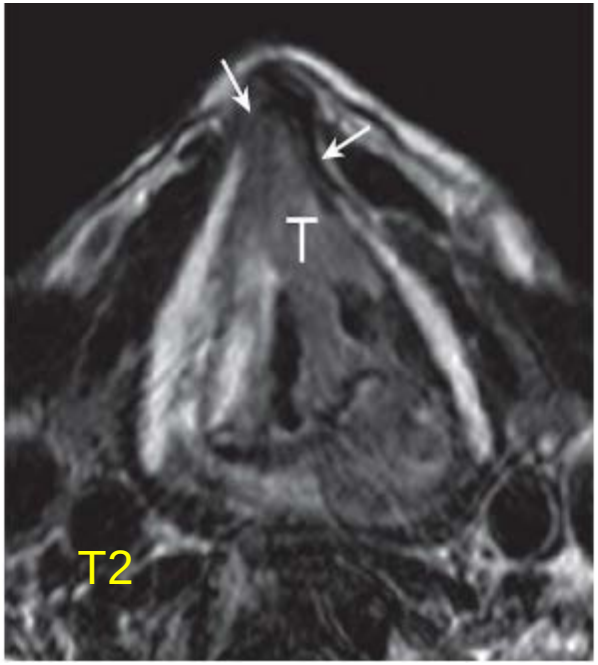


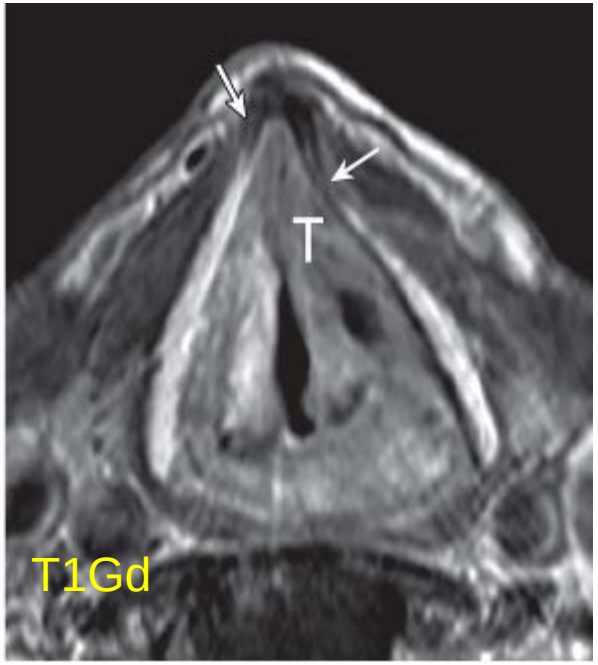


MP 1946 increasing hoarseness, fixed vocal cord

infiltration of thyroid cartilage

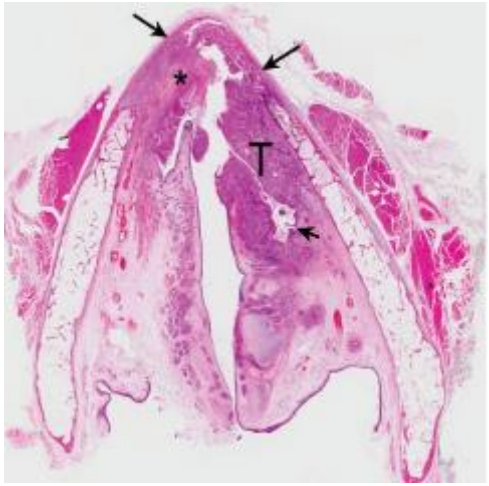






Resonance thyroid cart. when involved with tu

T 1	low
T2	~ tumour
T1 + Gd	~ tumour



Resonance thyroid cart. + inflammation

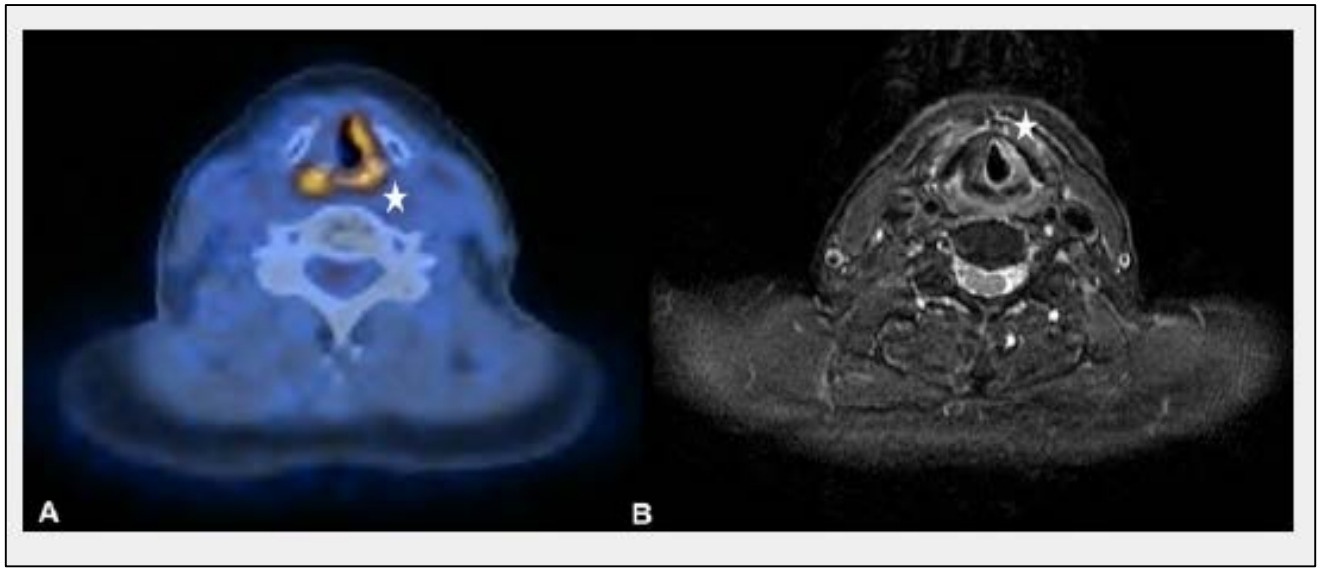
T 1	low
T2	> tumour
T1 + Gd	> tumour

Becker M. et al. Radiology 2008;249:551-561

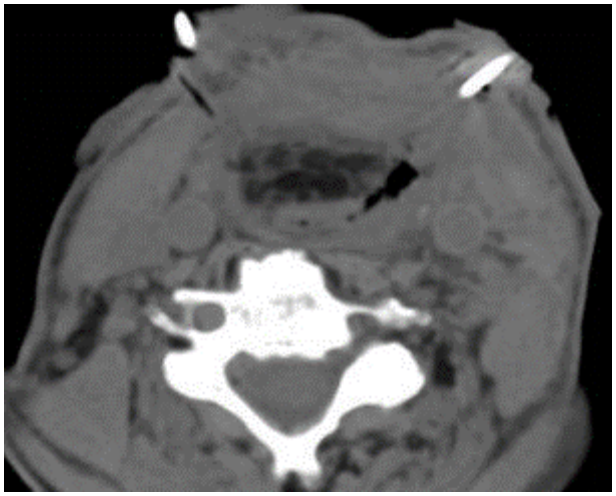
Identification of a morphologic correlate in PET-positive findings

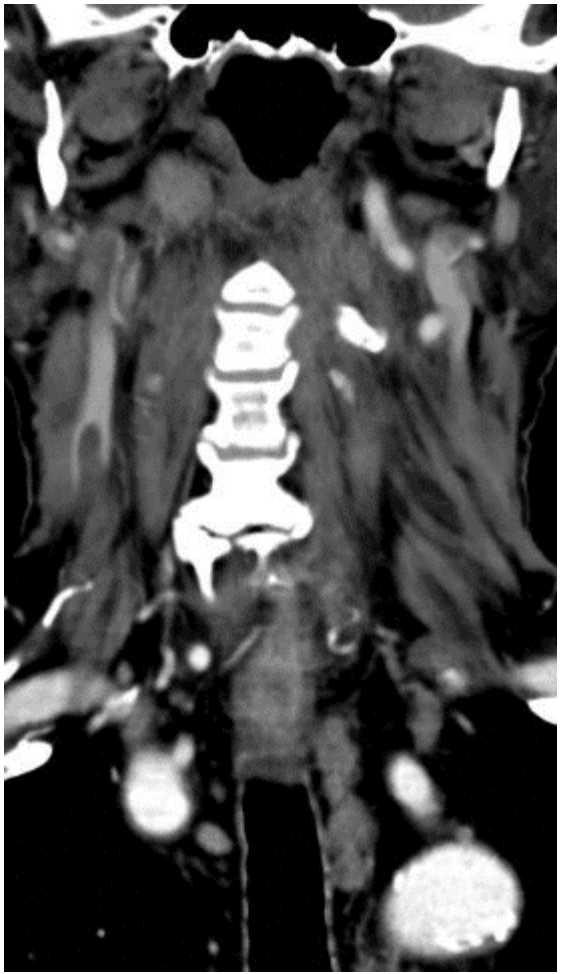
How aggressively shall we take biopsies?

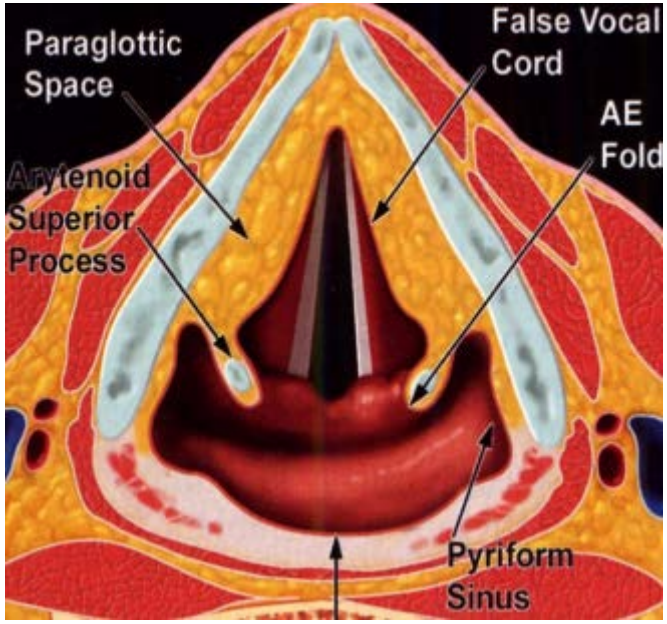
- Meerwein C et al. Post-treatment surveillance of head and neck cancer: pitfalls in the interpretation of FDG PET-CT/MRI. Swiss Med Wkly. 2015 Feb 21

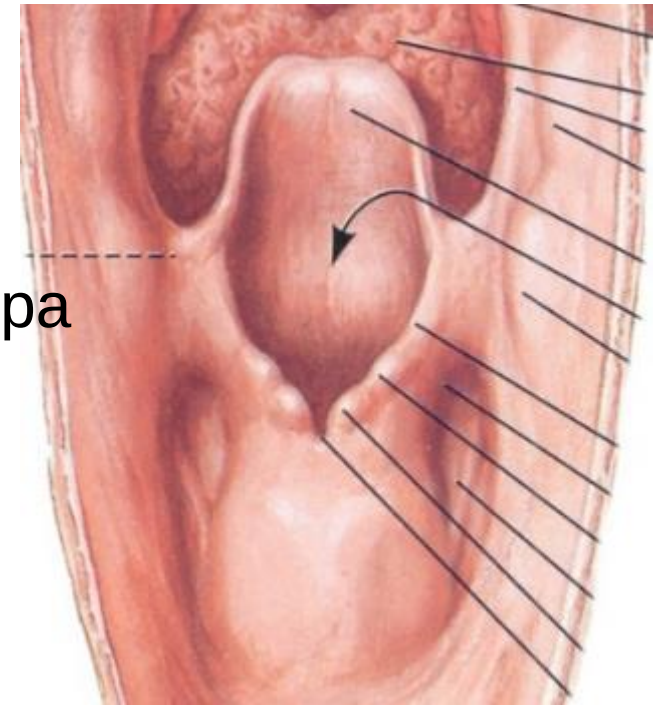


post laryngeal cancer



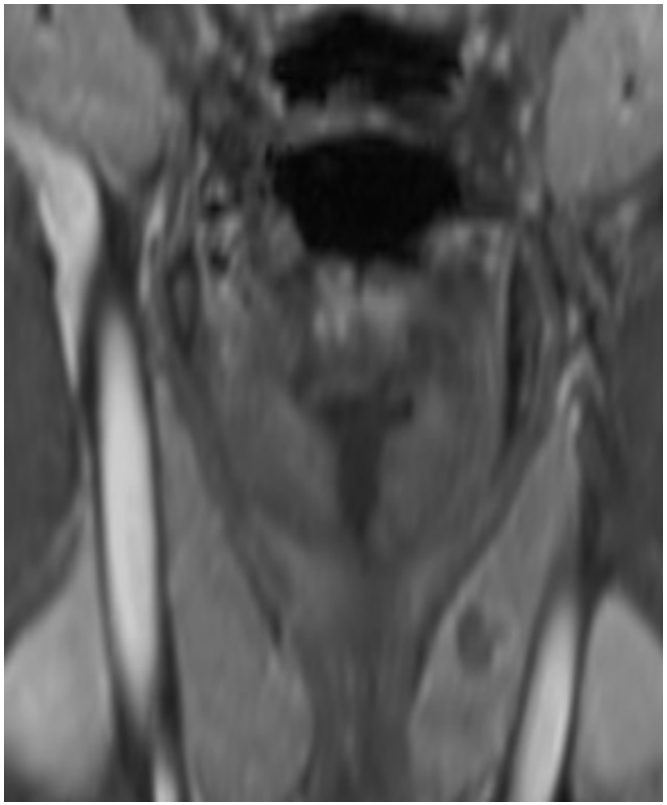






pa

hypopharynx:



piriform sinus; postcricoid region, posterior wall of pharyngeal wall

hypopharyngeal cancer

- piriform sinus 60%
- postcricoid region 25%
- posterior wall 15%

- 10% synchronous/ 25% metachronous primaries
- 50-75% metastatic lymph nodes
- prognosis: piriform sinus > posterior wall > postcricoid

staging hypopharyngeal- cancer:

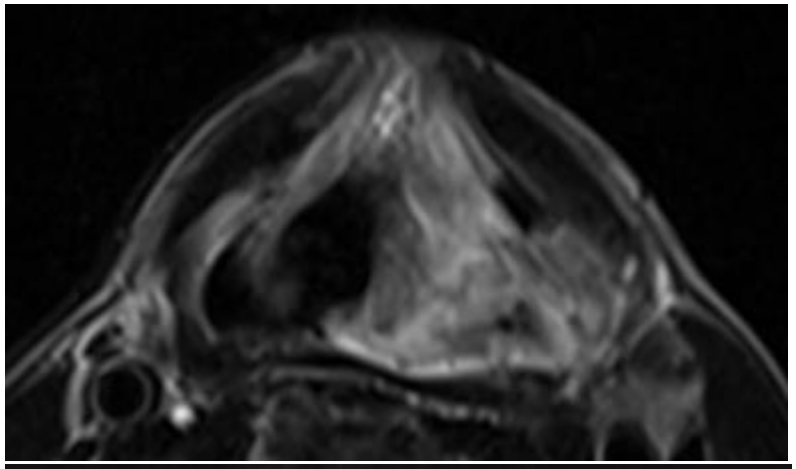
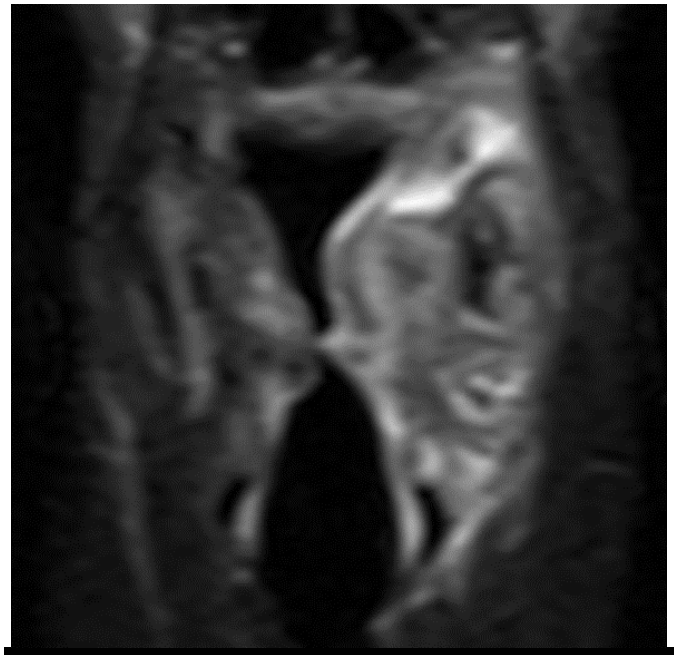
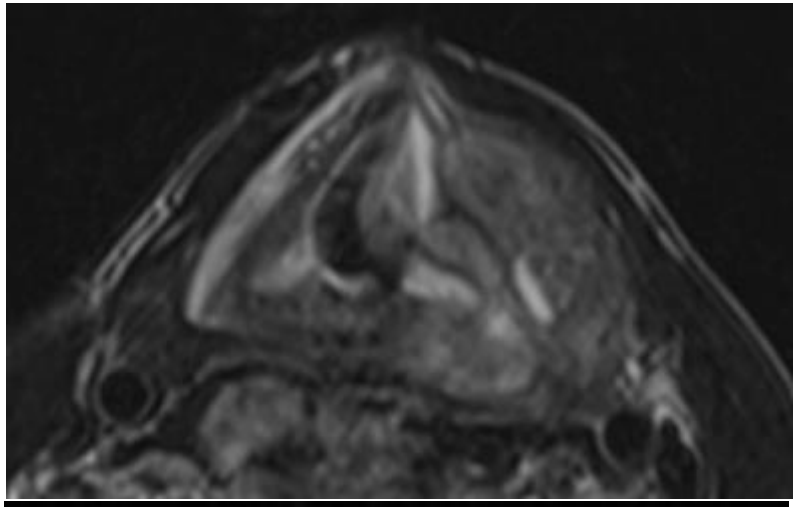
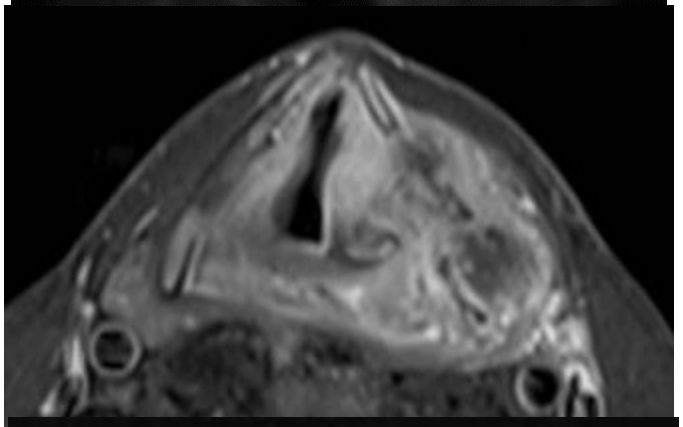
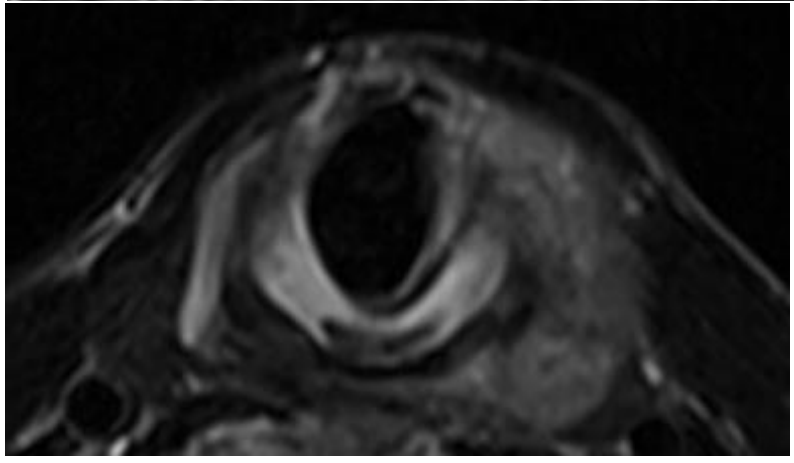
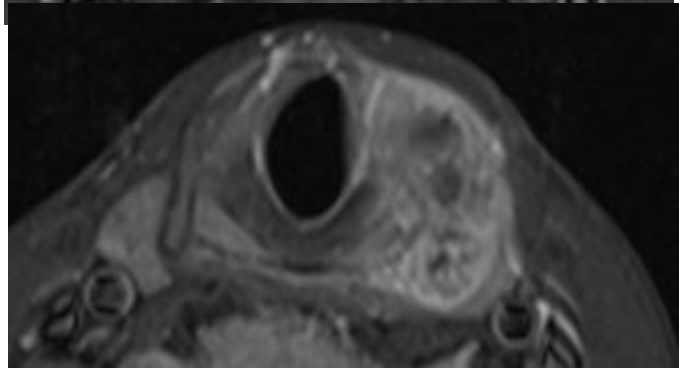
T1: Tu infiltrates 1 „region“ of hypopharynx is ≤ 2cm in maximal extension

T2 : Tu infiltrates > 1 „region“ of hypopharynx &/or adjacent region, 2-4cm Ø, no laryngeal fixation

T3: Tu > 4cm maximal extension or laryngeal fixation

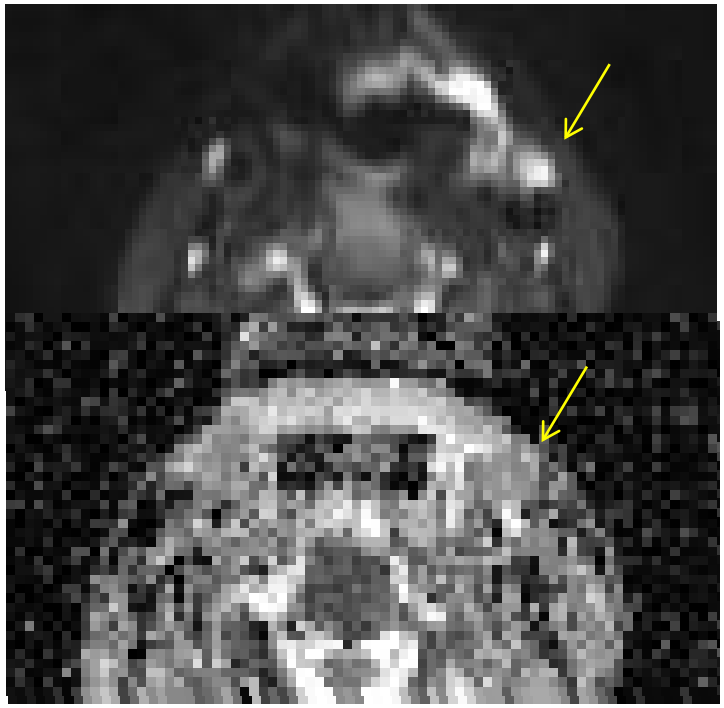
T4a: Tu infiltrates thyroid-, cricoid cartilage, hyoid, thyroid, esophagus, or soft tissues

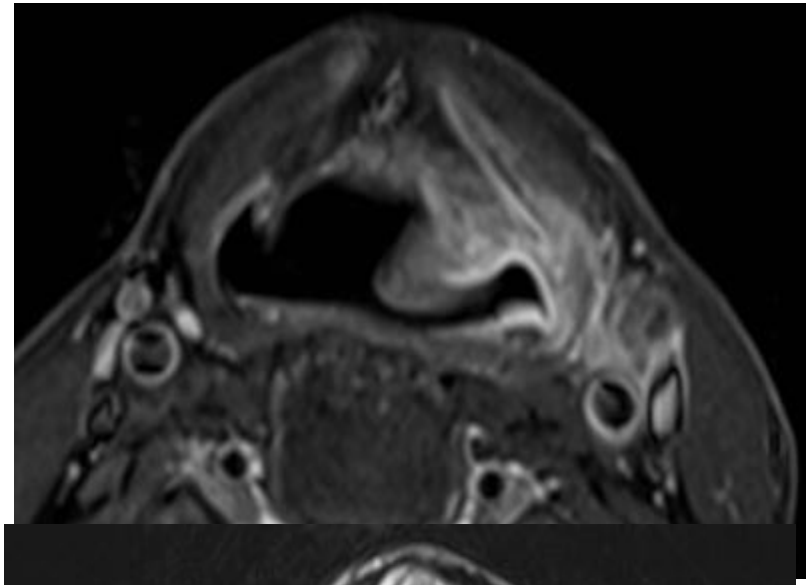
T4b: Tu infiltrates prevertebral fascia, encases ICA, infiltrates media-stinum

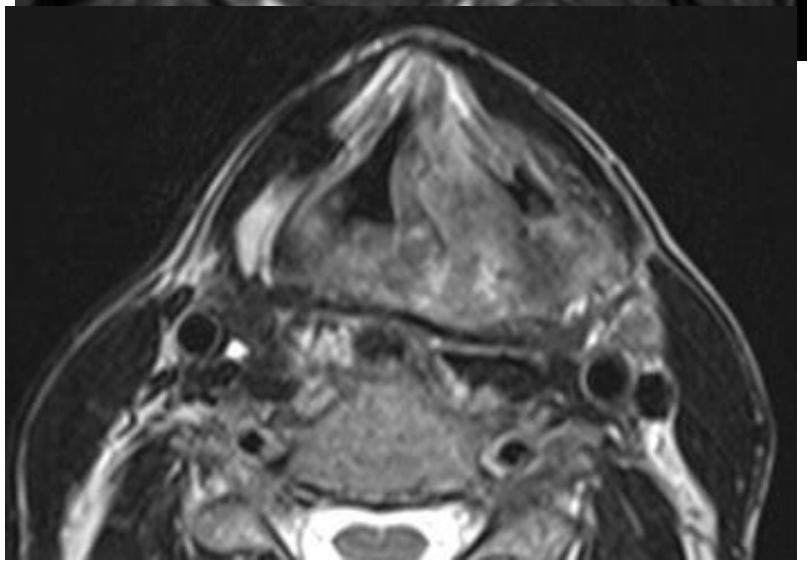







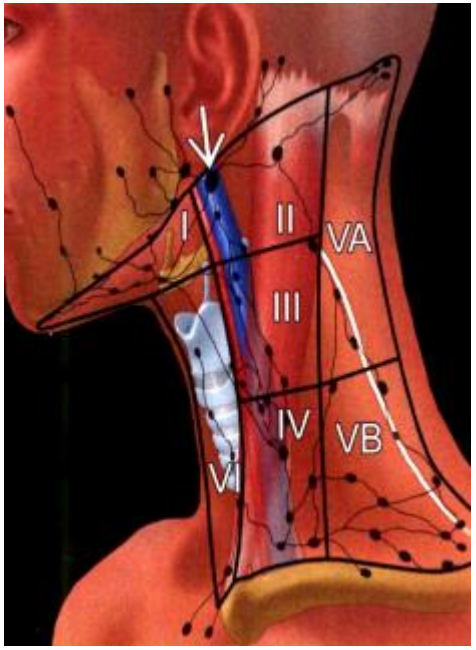
ln mets

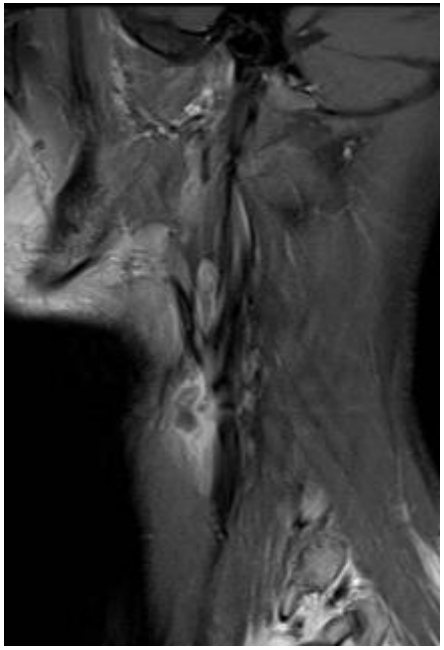
Level III











parotid-Space

tumours

- benign: pleomorphic adenoma, cystadeno-lymphoma (Whartin), oncocytoma, shwannoma of the facial nerve, lipoma…
- malignant: ACC, mucoepidermoid-, acinus cell-, salivary duct carcinoma, adenocarcinoma, Ca ex pleomorphic adenoma, MASC, NHL

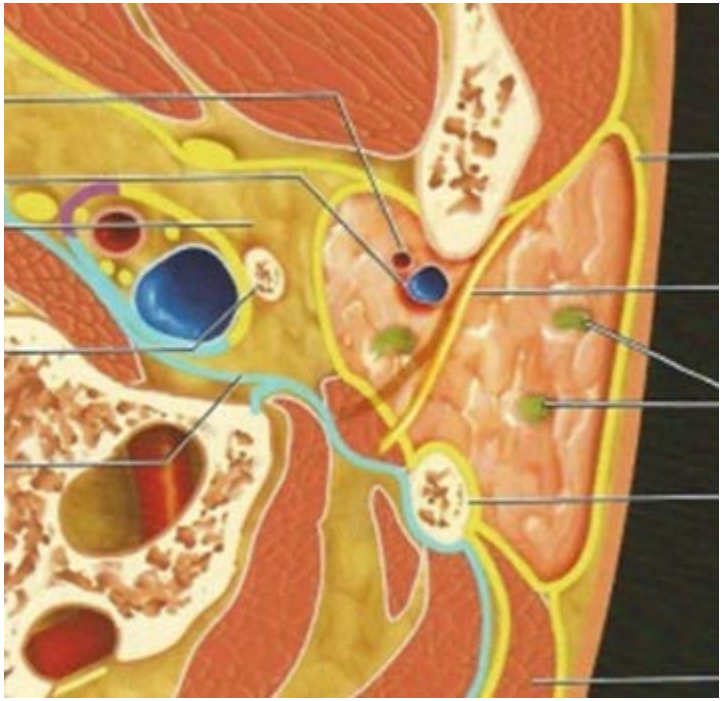
ln mets: SCC , melanoma, NHL

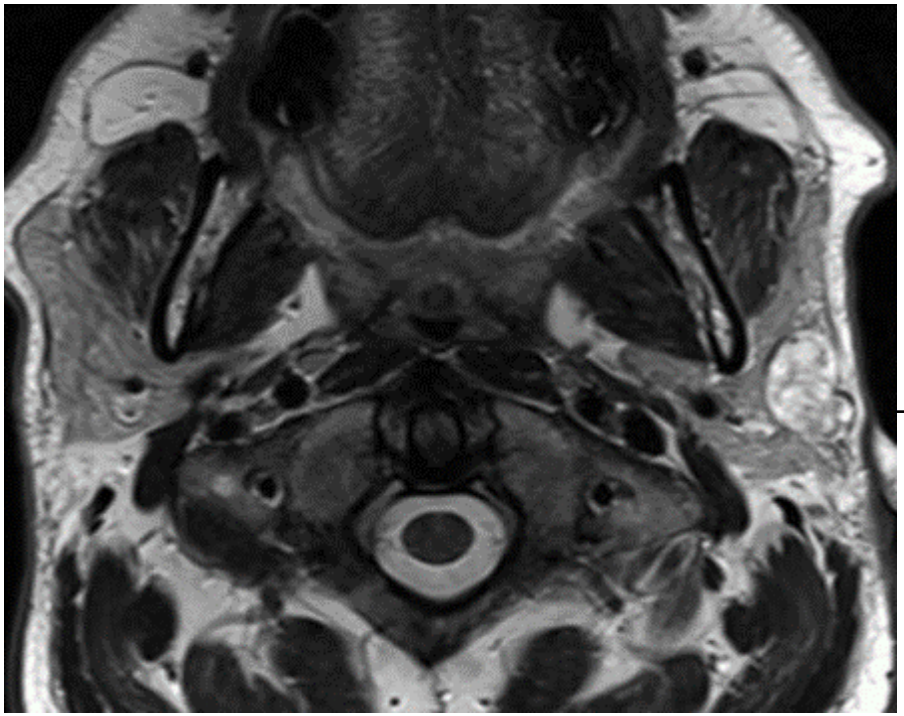
parotid gland

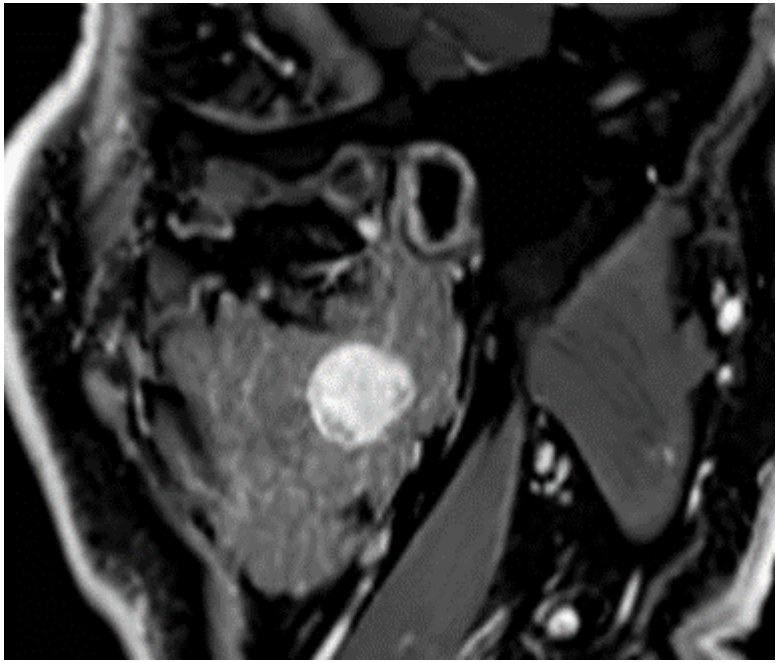
plane of facial nerve
Foramen stylomastoideum – V. retromandibularis)

- superficial lobe
- deep lobe

lymph nodes (~20)
ductus parotideus (Stenson's duct)
accessory lobe(s) (20%)

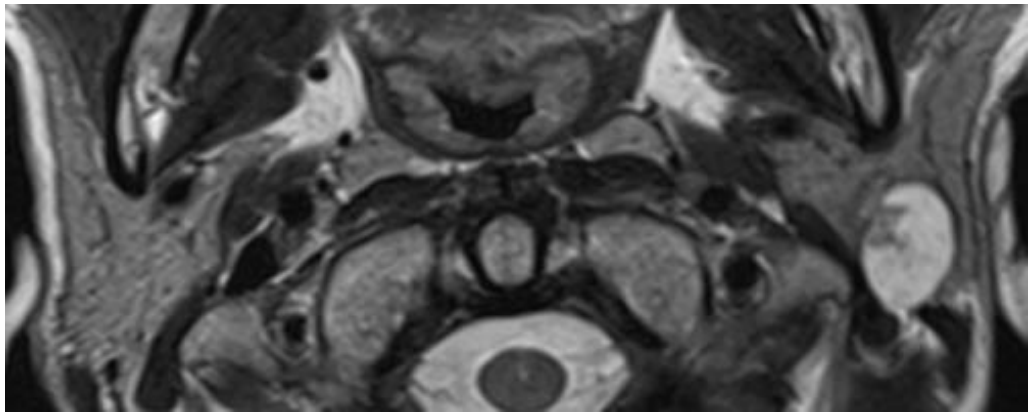




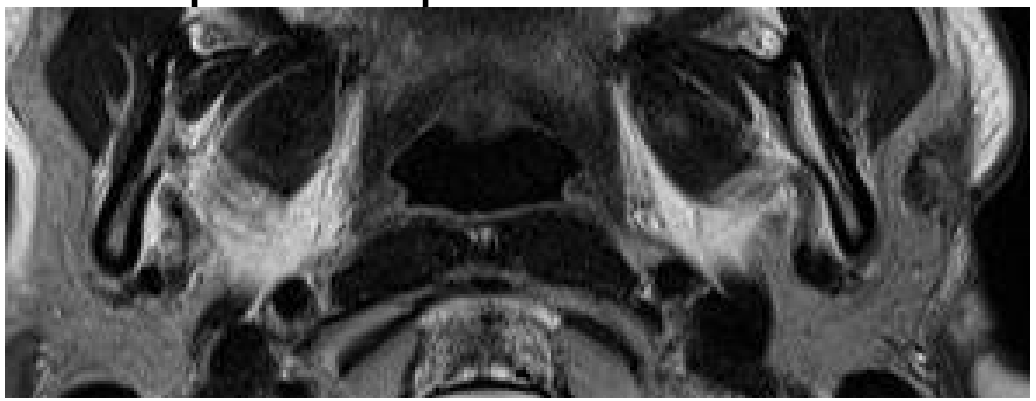


parotid lesions: superficial lobe

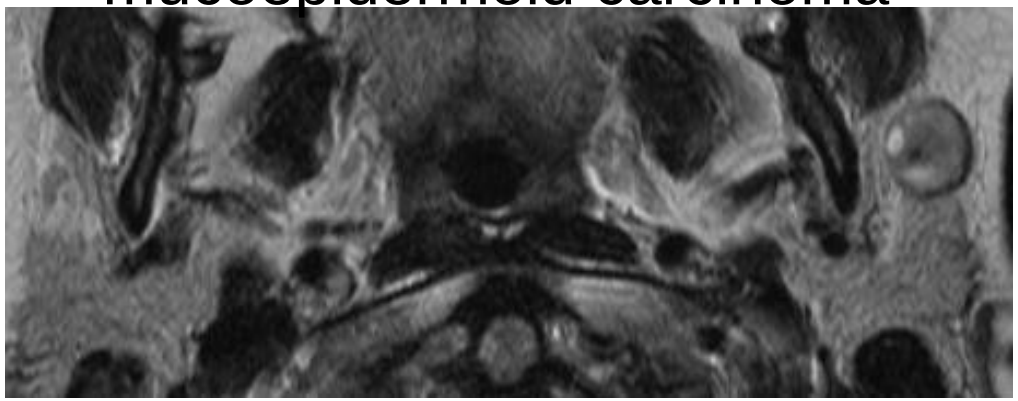
imaging ≠ histology



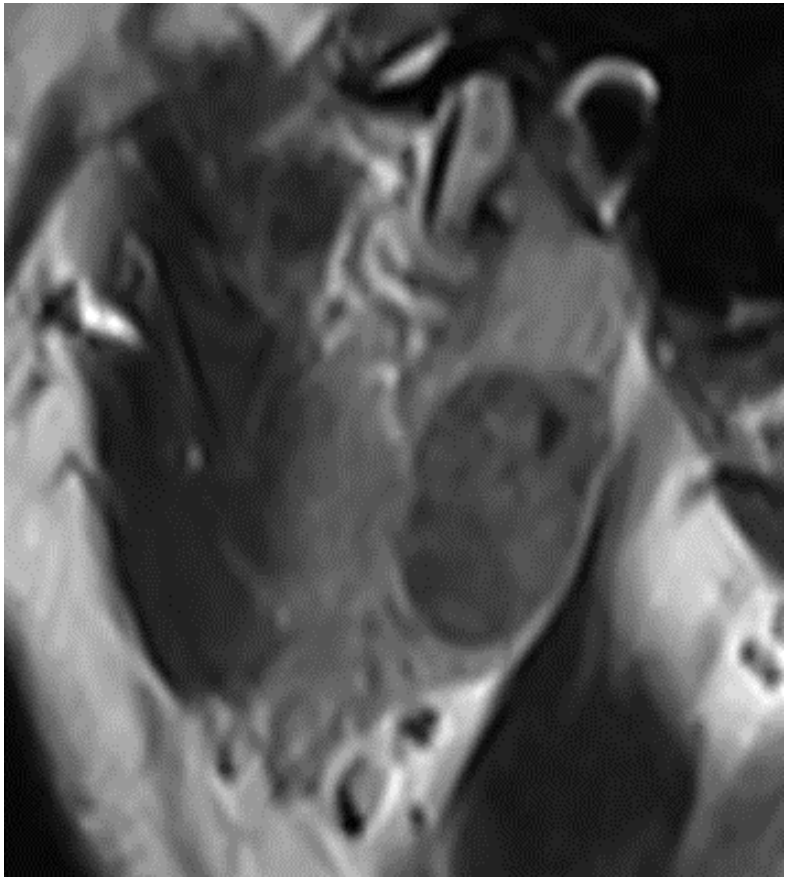
pleomorphic adenoma



mucoepidermoid carcinoma

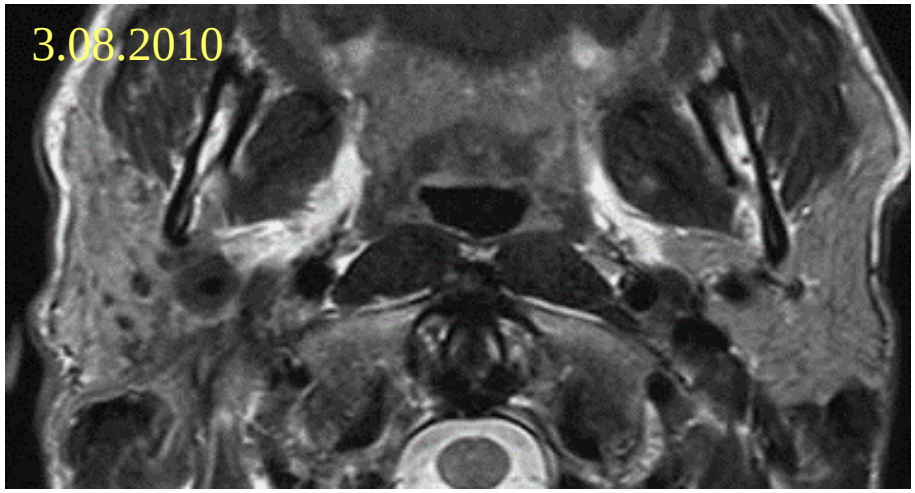


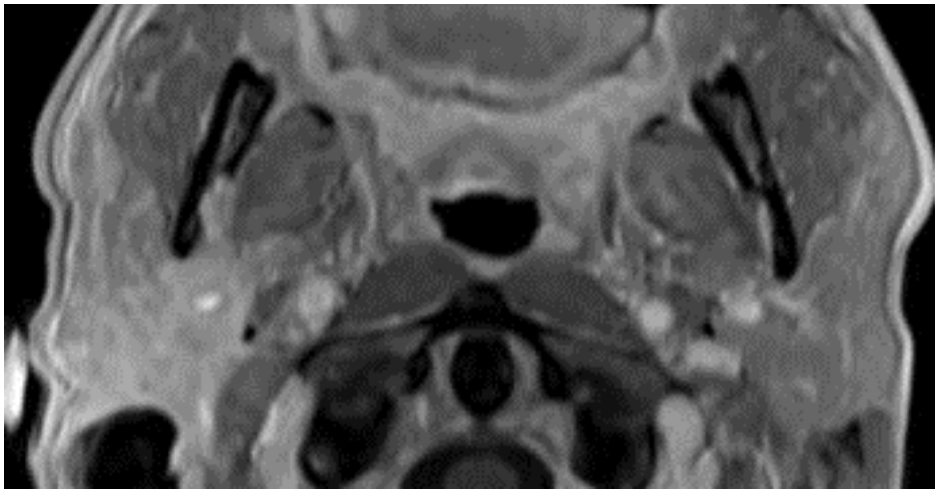
lymph node metastasis

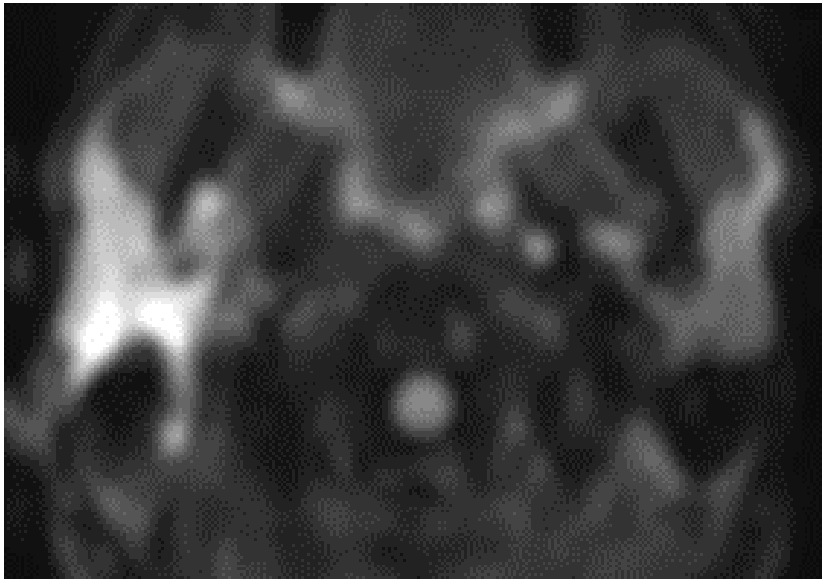


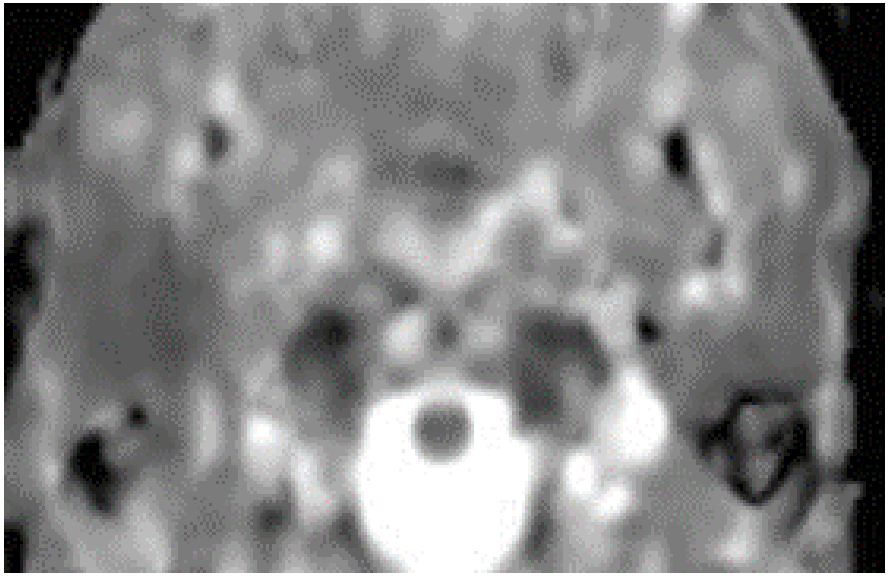
cystadenolymphoma

ACC parotid gland

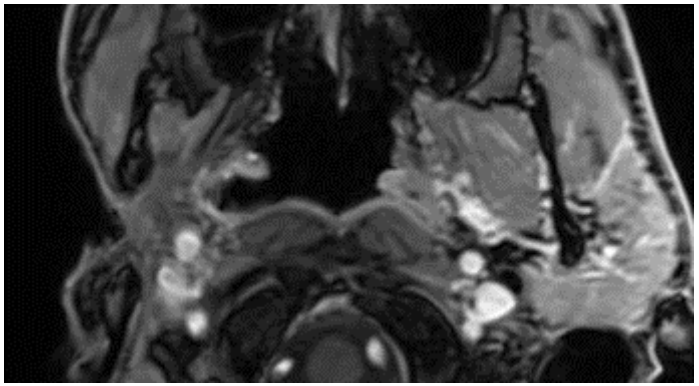




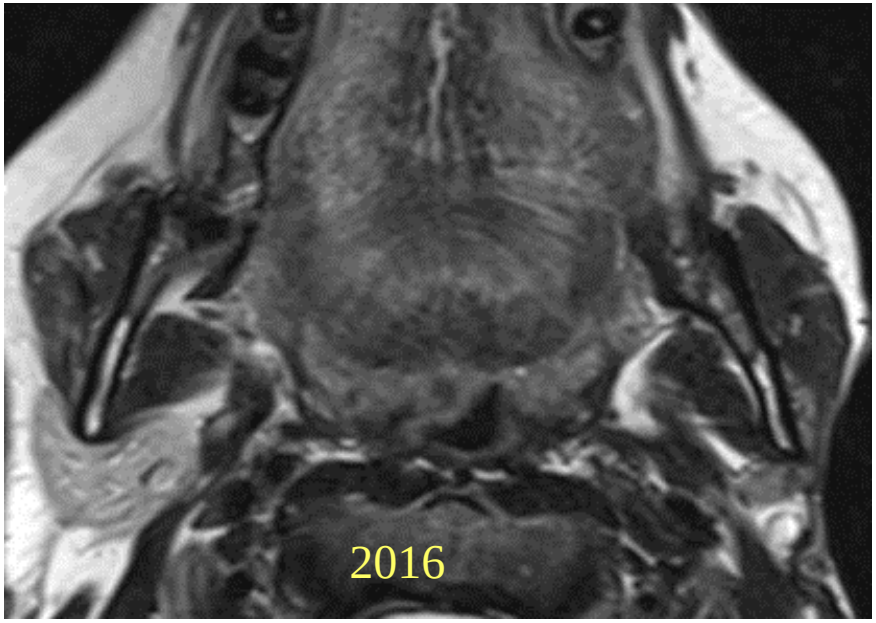


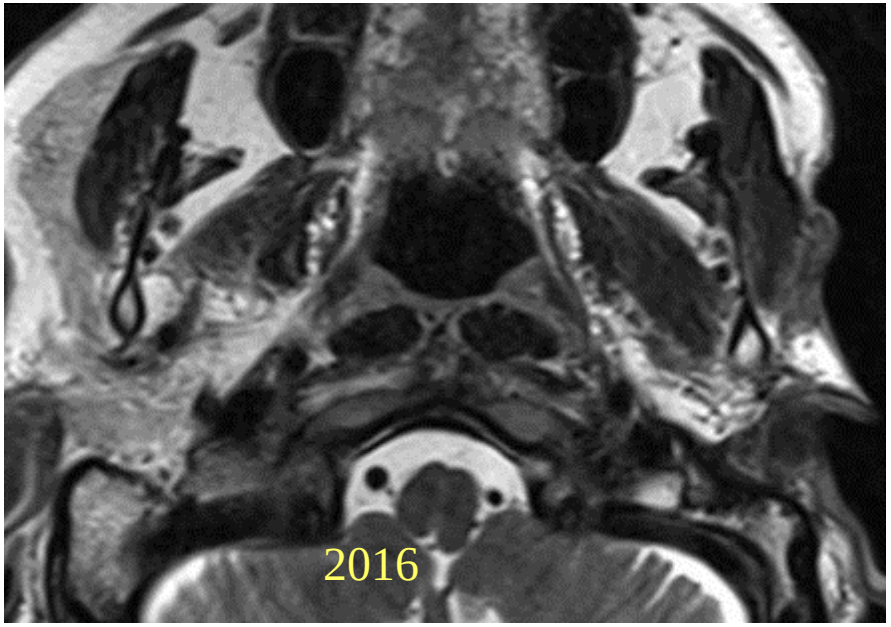


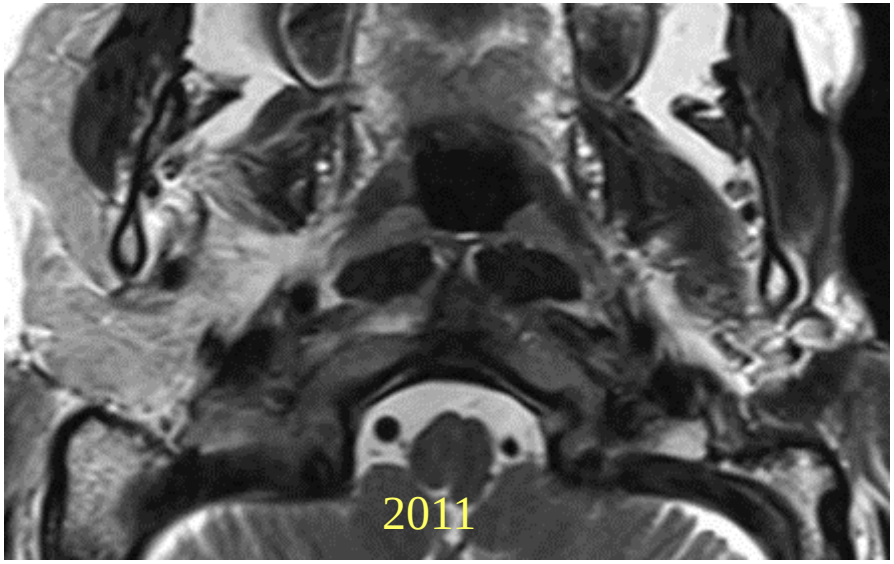
postop/RT course

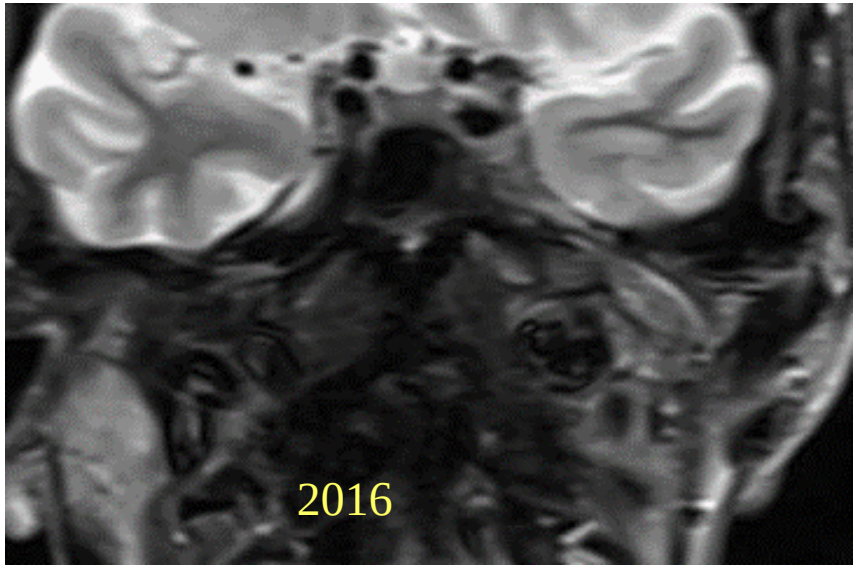


St. n. ACC 2000

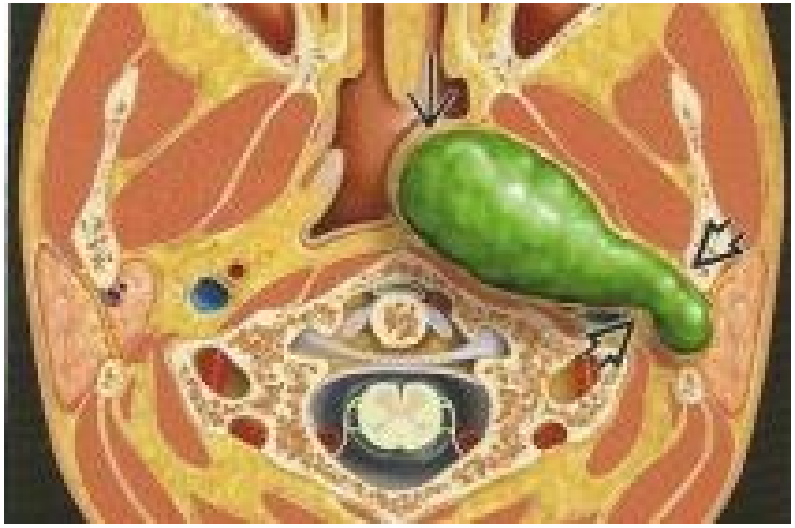


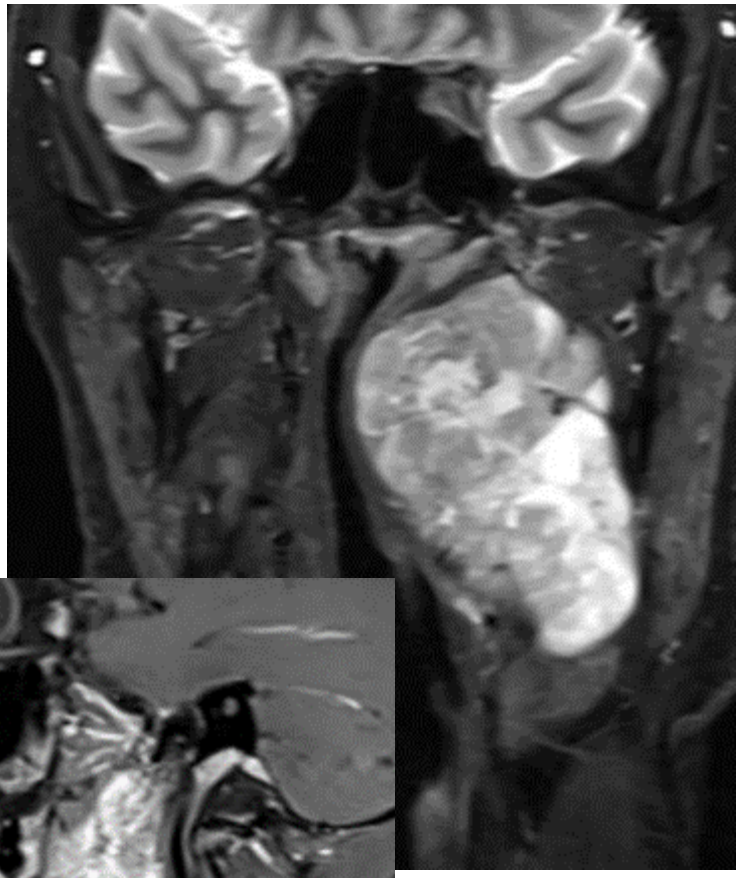


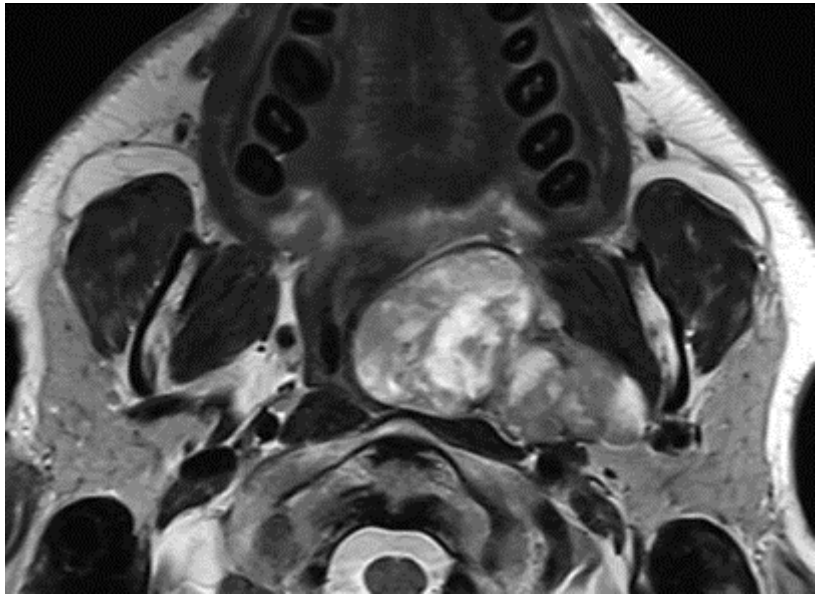


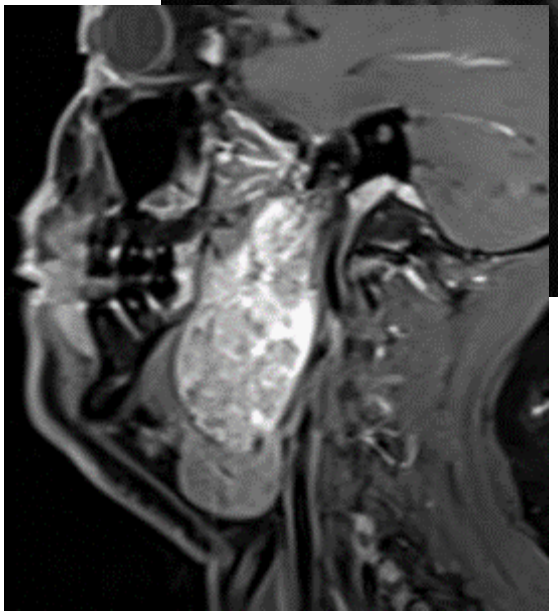


parotid lesions: deep lobe

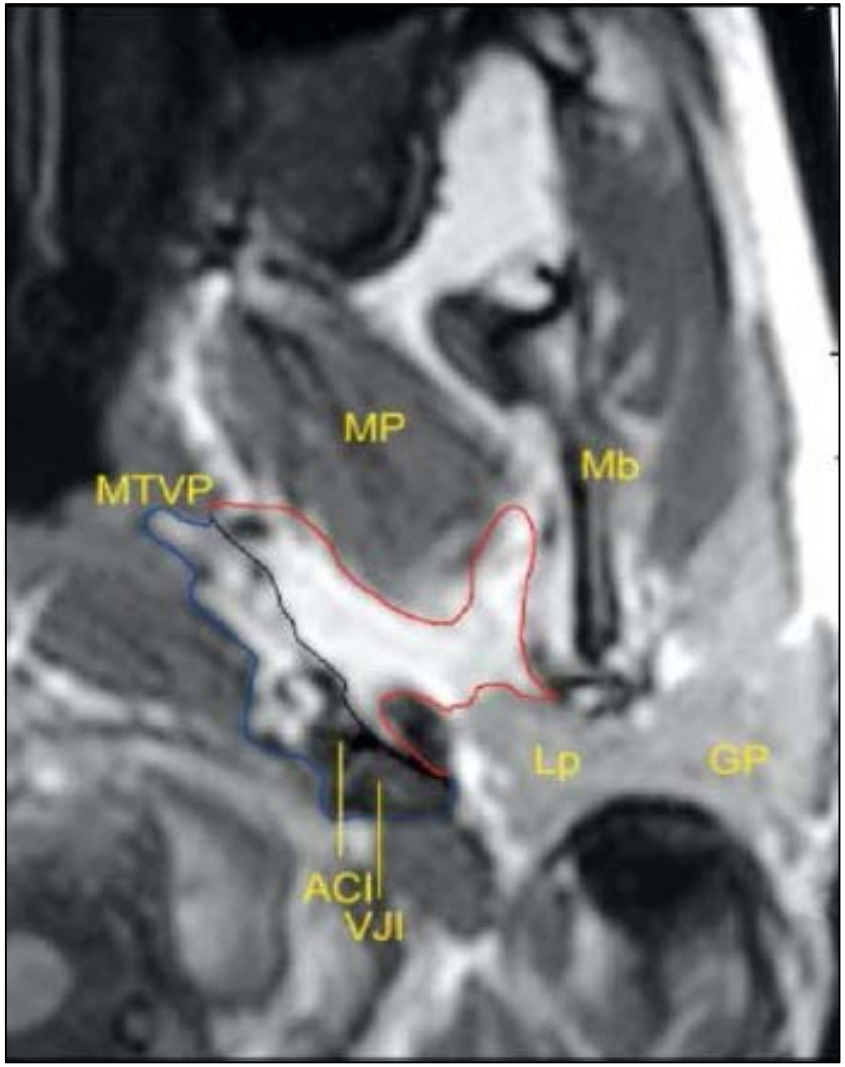


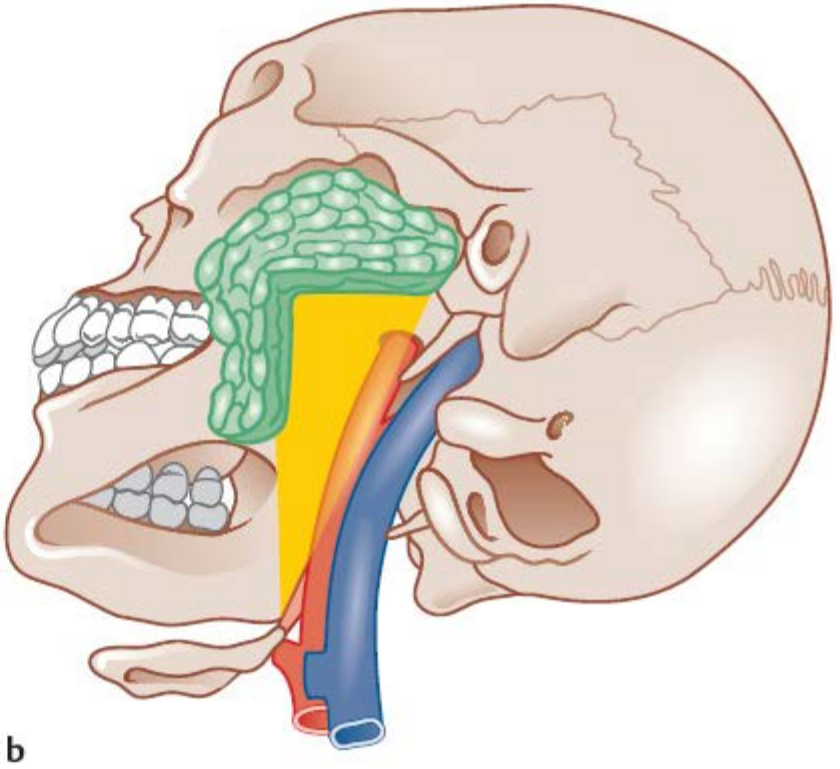






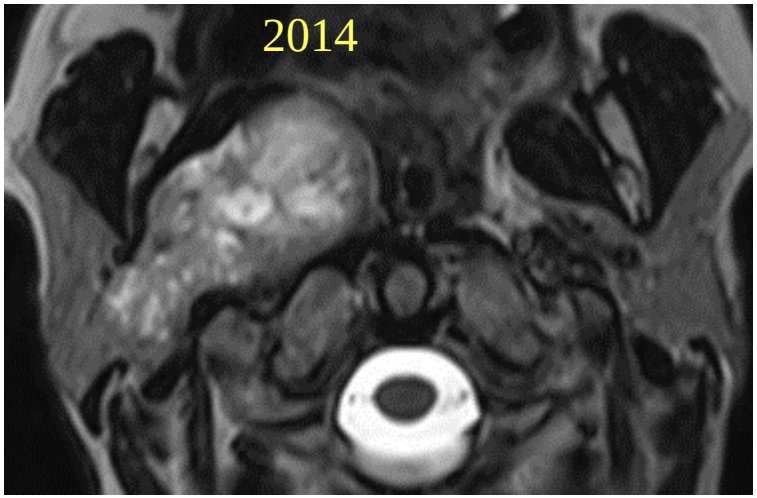
pre- or. poststyloidal compartment

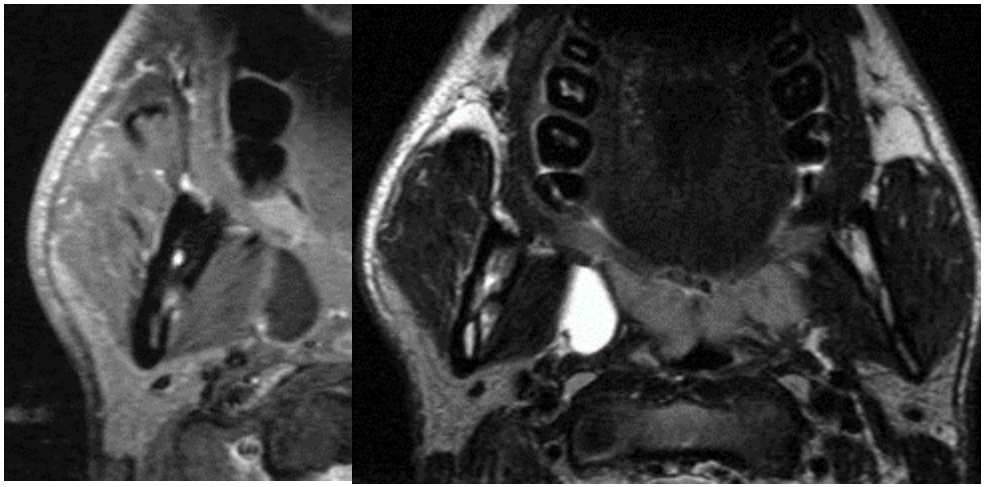


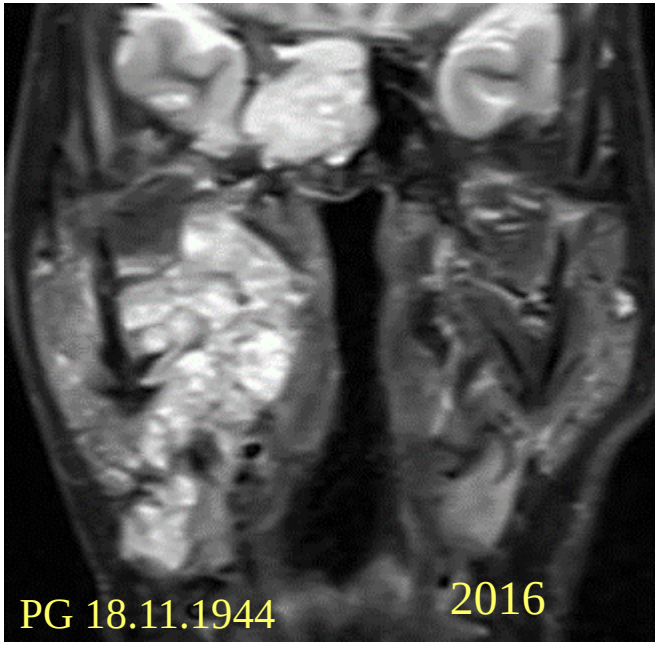


parapharyngeal space lesions

extrinsic ↔ intrinsic

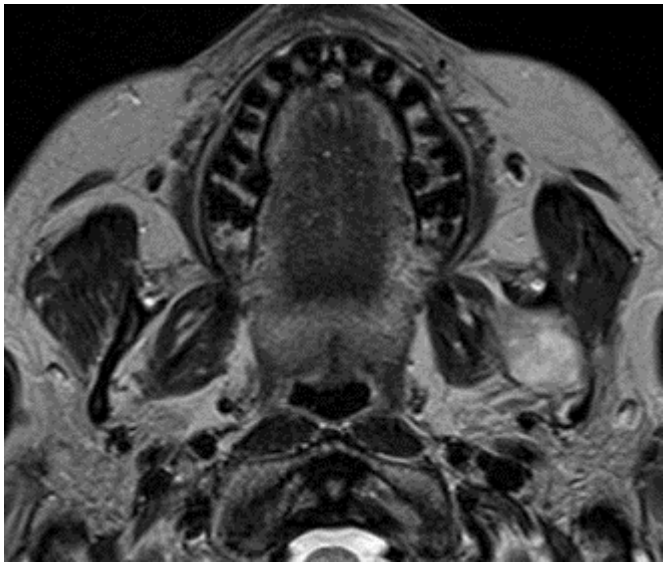


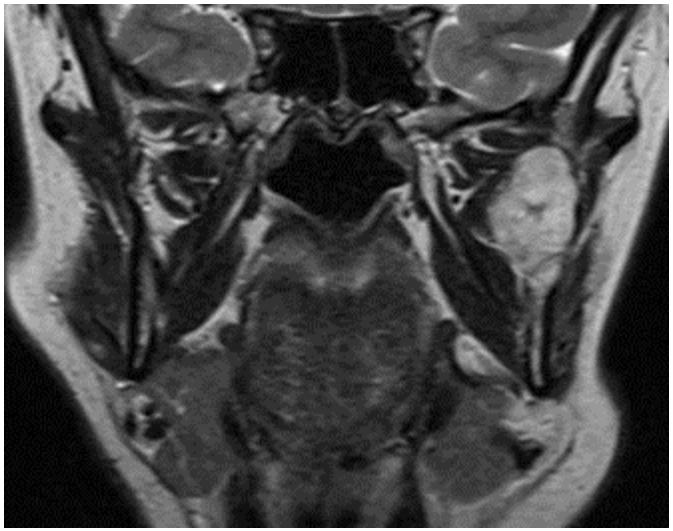




masticator space lesions

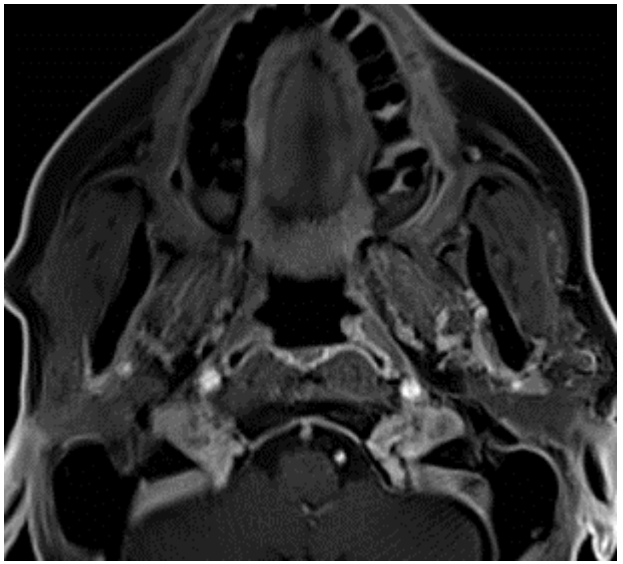
inferior alveolar nerve, neurinoma.

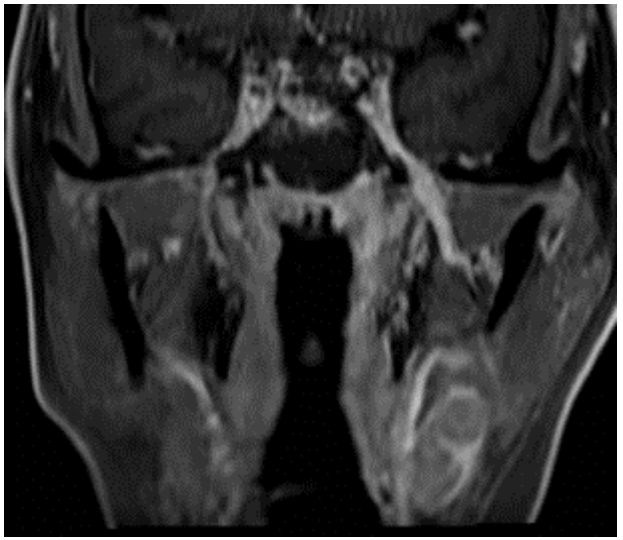




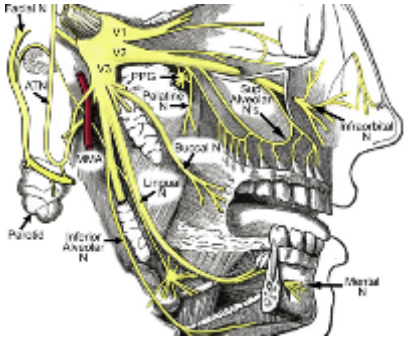
Target sign →shwannoma or neurofibroma

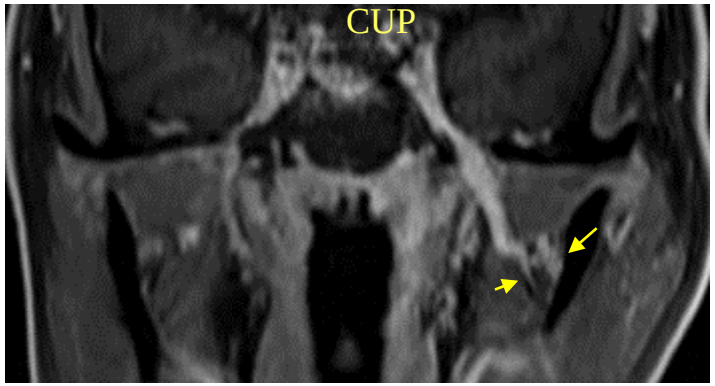
V3: perineural tu extension

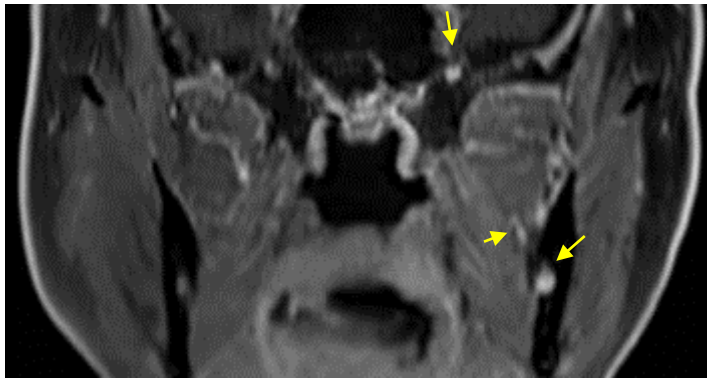


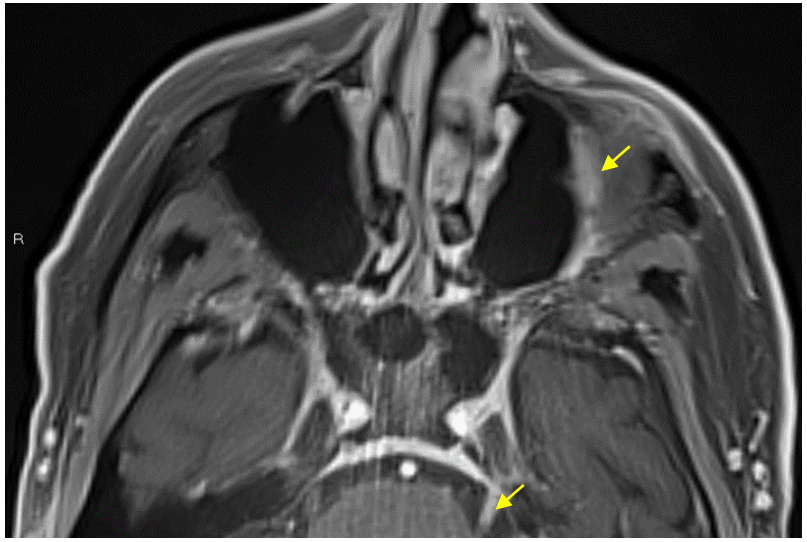


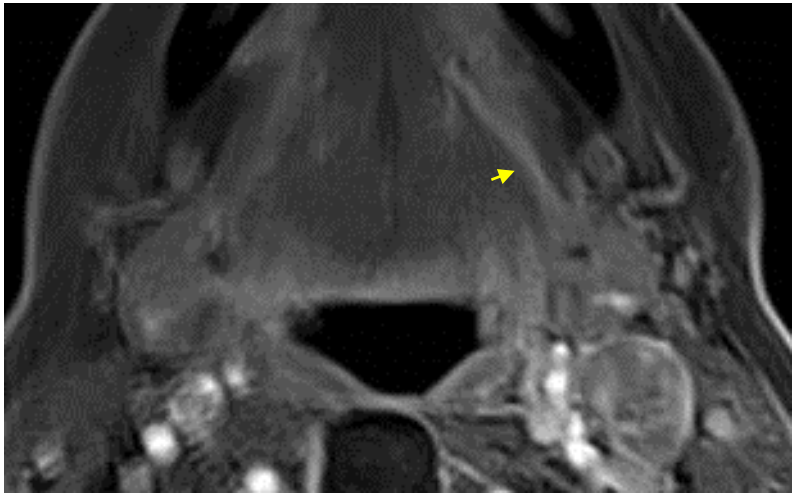
retrograde - antegrade perineural extension





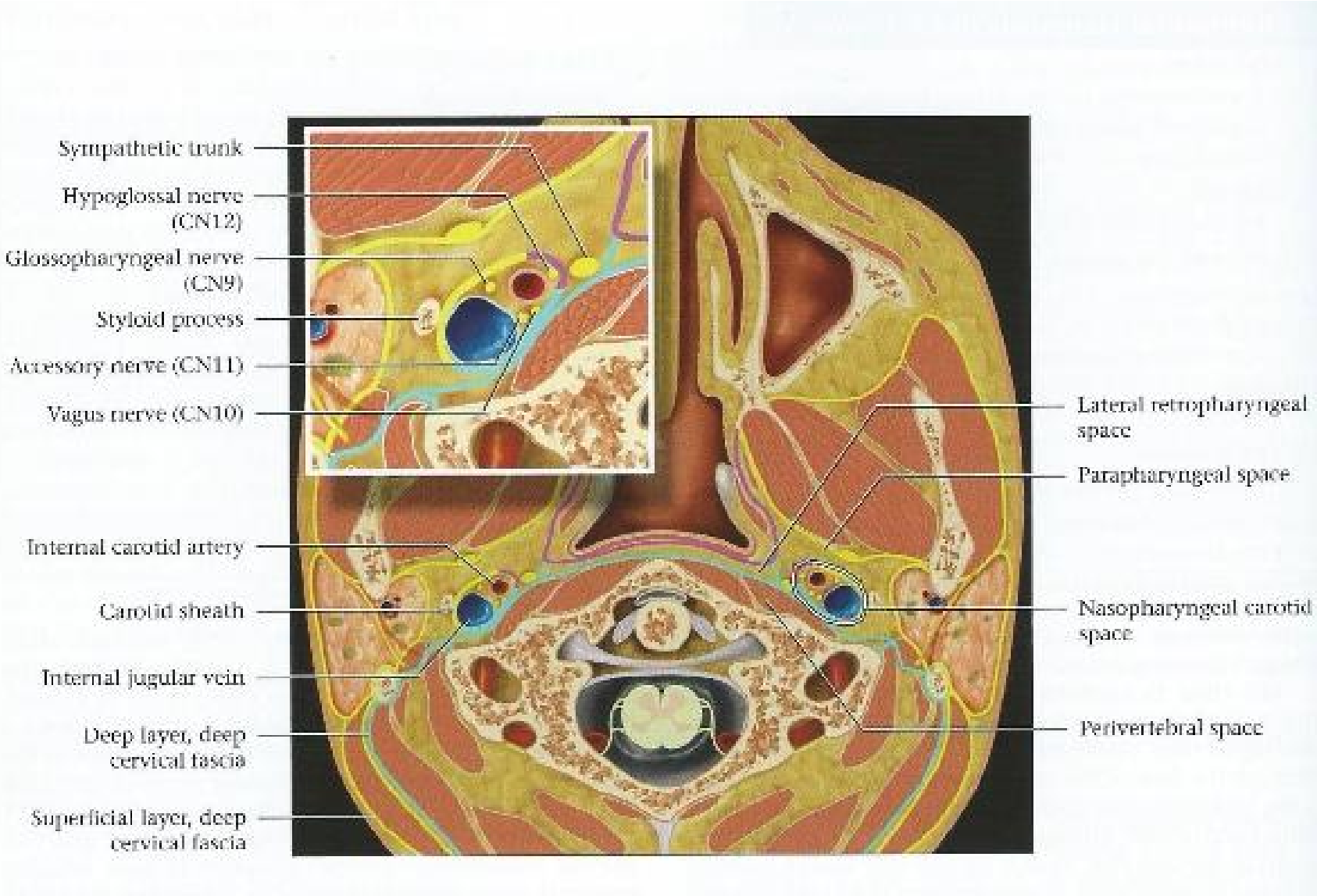






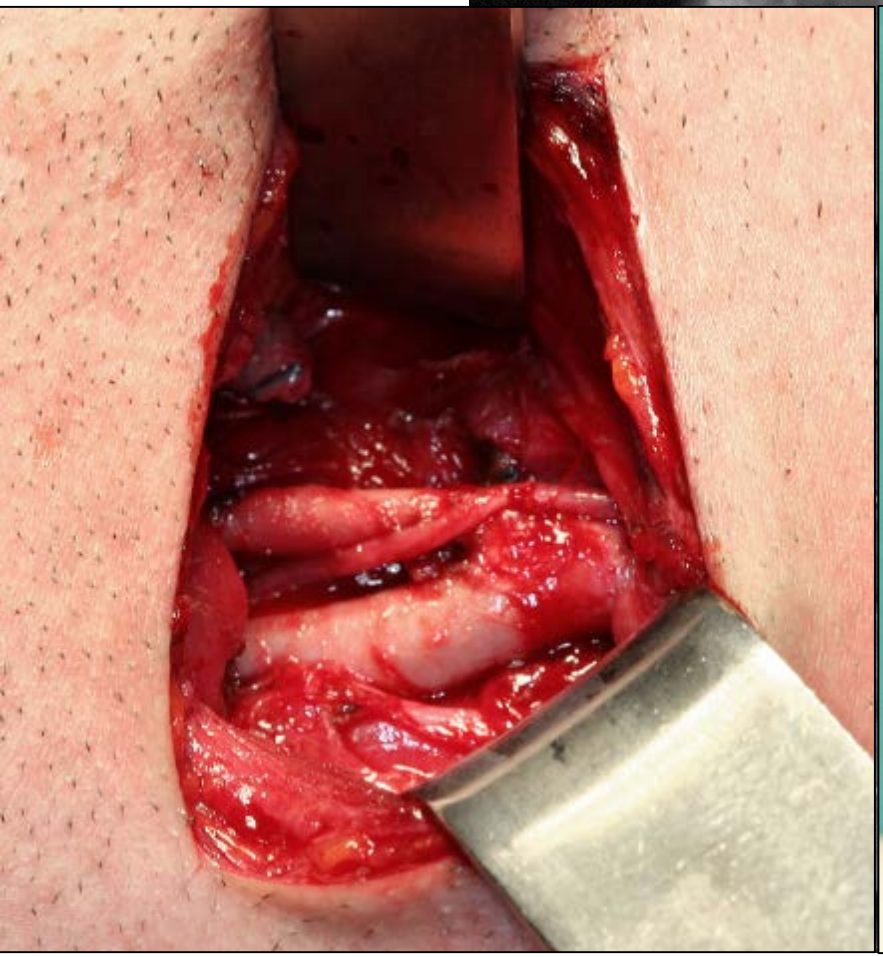
Mandibular nerve → inf. alveolar n.
→ lingual n.
Maxillary nerve → infraorbital n.

suprahyoidal carotid space

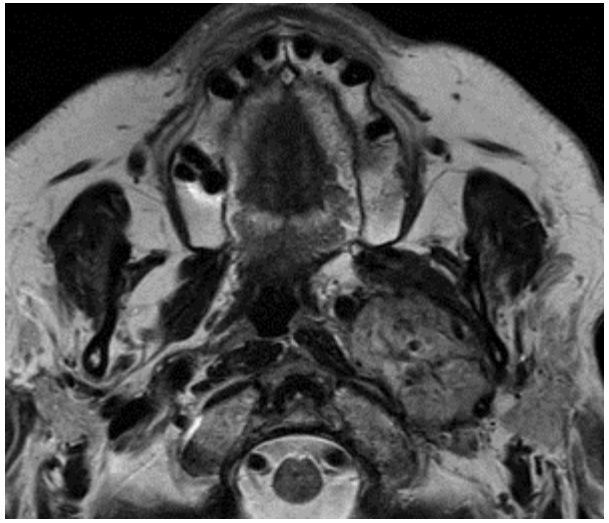


carotid space

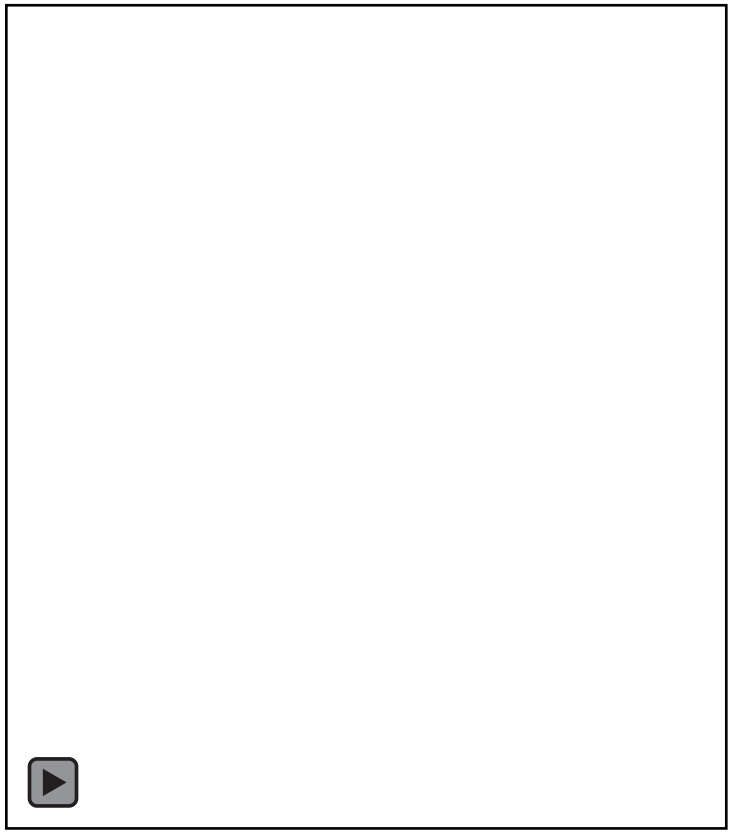
Glomus caroticum



carotid space



carotid space



- We only find what we look for,
- we only look for what we know,
- we know what to look for

if somebody tells us

Thank you for your attention!

„sleeping angler“ by Robert Seymour