



A.I.R.O. GRUPPO DI STUDIO TESTA COLLO

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**WORKSHOP SU IMPOSTAZIONE RADIOTERAPICA NEI TUMORI
DEL RINOFARINGE**

Contornazione di GTV, CTVs e OARs nei tumori del rinofaringe

Michele Cianciulli



U.O.C. Radioterapia
Azienda Ospedaliera San Camillo – Forlanini
Roma
Direttore: Prof. V. Donato



**American Joint Committee on Cancer (AJCC)
TNM Staging System for the Pharynx (7th ed., 2010)**
(Nonepithelial tumors such as those of lymphoid tissue, soft tissue, bone, and cartilage are not included)

Primary Tumor (T)

TX Primary tumor cannot be assessed
T0 No evidence of primary tumor
Tis Carcinoma *in situ*

Nasopharynx

T1 Tumor confined to the nasopharynx, or tumor extends to oropharynx and/or nasal cavity without parapharyngeal extension*
T2 Tumor with parapharyngeal extension*
T3 Tumor involves bony structures of skull base and/or paranasal sinuses
T4 Tumor with intracranial extension and/or involvement of cranial nerves, hypopharynx, orbit, or with extension to the infratemporal fossa/masticator space

*Note: Parapharyngeal extension denotes posterolateral infiltration of tumor.

Regional Lymph Nodes (N)

Nasopharynx

The distribution and the prognostic impact of regional lymph node spread from nasopharynx cancer, particularly of the undifferentiated type, are different from those of other head and neck mucosal cancers and justify the use of a different N classification system.

NX Regional lymph nodes cannot be assessed
N0 No regional lymph node metastasis
N1 Unilateral metastasis in cervical lymph node(s), 6 cm or less in greatest dimension, above the supraclavicular fossa, and/or unilateral or bilateral, retropharyngeal lymph nodes, 6 cm or less, in greatest dimension*
N2 Bilateral metastasis in cervical lymph node(s), 6 cm or less in greatest dimension, above the supraclavicular fossa*
N3 Metastasis in a lymph node(s)* > 6 cm and/or to supraclavicular fossa
N3a More than 6 cm in dimension
N3b Extension to the supraclavicular fossa**

Anatomic Stage/Prognostic Groups: Nasopharynx

Stage 0	Tis	N0	M0
Stage I	T1	N0	M0
Stage II	T1	N1	M0
	T2	N0	M0
	T2	N1	M0
Stage III	T1	N2	M0
	T2	N2	M0
	T3	N0	M0
	T3	N1	M0
Stage IVA	T3	N2	M0
	T4	N0	M0
	T4	N1	M0
Stage IVB	T4	N2	M0
	Any T	N3	M0
Stage IVC	Any T	Any N	M1

Histologic Grade (G)

GX Grade cannot be assessed
G1 Well differentiated
G2 Moderately differentiated
G3 Poorly differentiated
G4 Undifferentiated



National
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NCCN Guidelines Version 1.2013 Cancer of the Nasopharynx

DEFINITIVE

RT Alone (preferred if no chemotherapy is being used)

- Planning target volume (PTV)
 - ▶ High risk: Primary tumor and involved lymph nodes (this includes possible local subclinical infiltration at the primary site and at the high-risk level lymph node(s))
 - ◊ 66 Gy (2.2 Gy/fraction) to 70 Gy (2.0 Gy/fraction); daily Monday-Friday in 6-7 weeks
- Intermediate and low risk: Sites of suspected subclinical spread
 - ▶ 44 Gy (2.0 Gy/fraction) to 60 Gy (1.6 Gy/fraction)²

CONCURRENT CHEMORADIATION³

(preferred for patients eligible for chemotherapy)

- PTV
 - ▶ High risk: typically 70 Gy (2.0 Gy/fraction)
 - ▶ Intermediate and low risk: 44 Gy (2.0 Gy/fraction) to 60 Gy (1.6 Gy/fraction)²

IMRT is preferred over 3D conformal RT in cancer of the nasopharynx to minimize dose to critical structures.

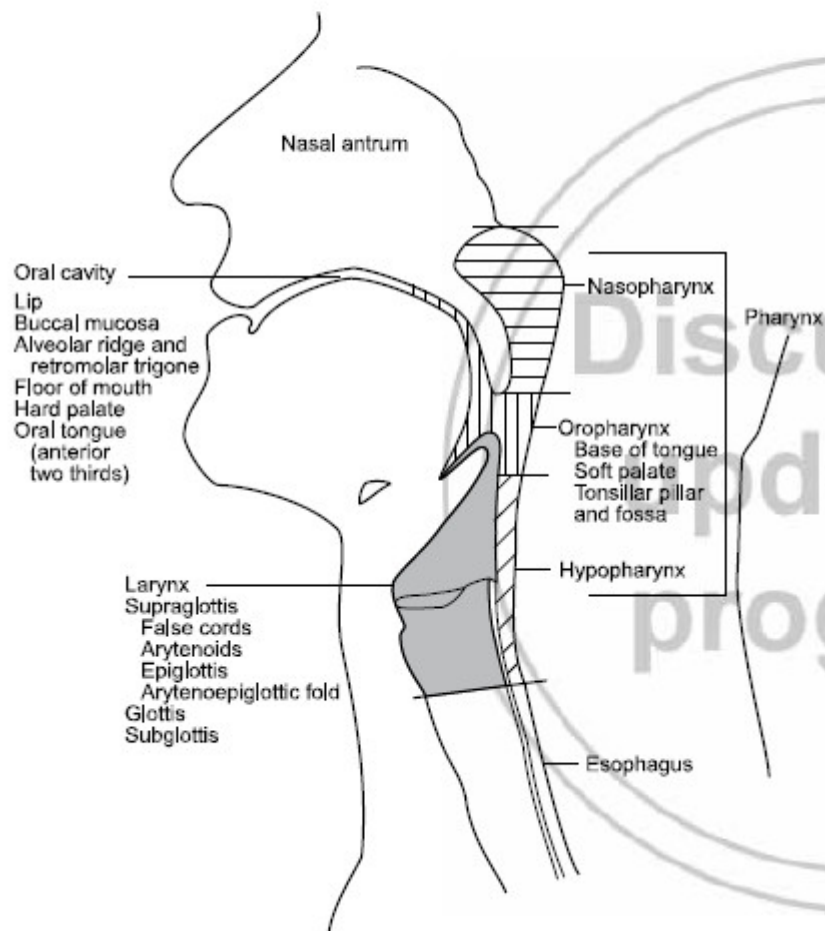
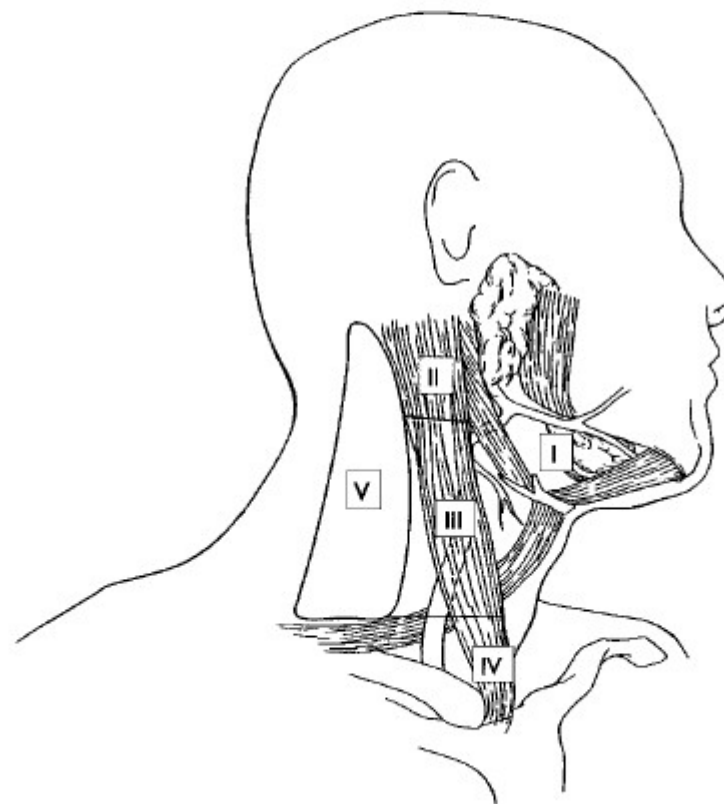
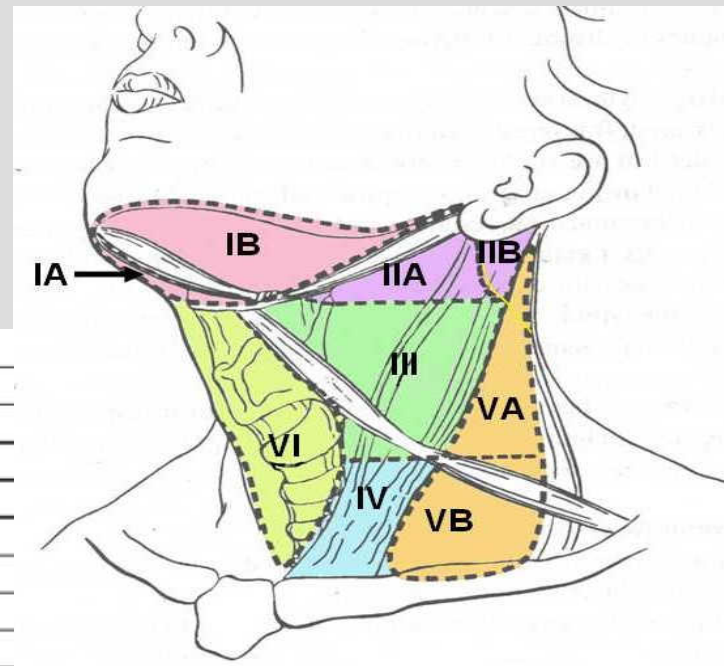
Figure 1: Anatomic Sites and Subsites of the Head and Neck**Figure 2: Level Designation for Cervical Lymphatics in the Right Neck**

Table 4 Lymph node level (adapted to [17])

Lymph node level	Terminology	Lymph node regions
level IA	submental	LN submentales
level IB	submandibular	LN submandibulares
level IIA	ventral upper jugular group	LN ventrales jugulares superiores
level IIB	dorsal upper jugular group	LN dorsales jugulares superiores
level III	mediales jugular group	LN jugulares mediales
level IV	lower jugular group	LN jugulares inferiores
level VA	posterior triangle group	LN cervicales posteriors profundi
level VB	posterior triangle group	LN supraclaviculares
level VI	anterior compartment	LN cervicales anteriores superficiales LN cervicales anteriores profundi: - LN infrahyoidales - LN prelaryngeales - LN pretracheales - LN paratracheales - LN thyroidei
level retropharyngeal	retropharyngeal	LN retropharyngeales
level parotidal	parotidal	LN parotidei superficiales LN parotidei profundi
level retroauricular	retroauricular	LN retroauriculares
level occipital	occipital	LN occipitales
level buccal	buccal	LN faciales
level external jugular	external jugular	LN cervicales laterales superficiales



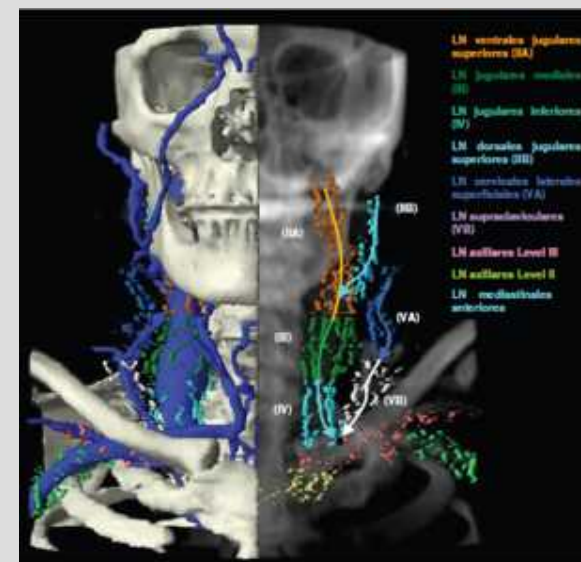
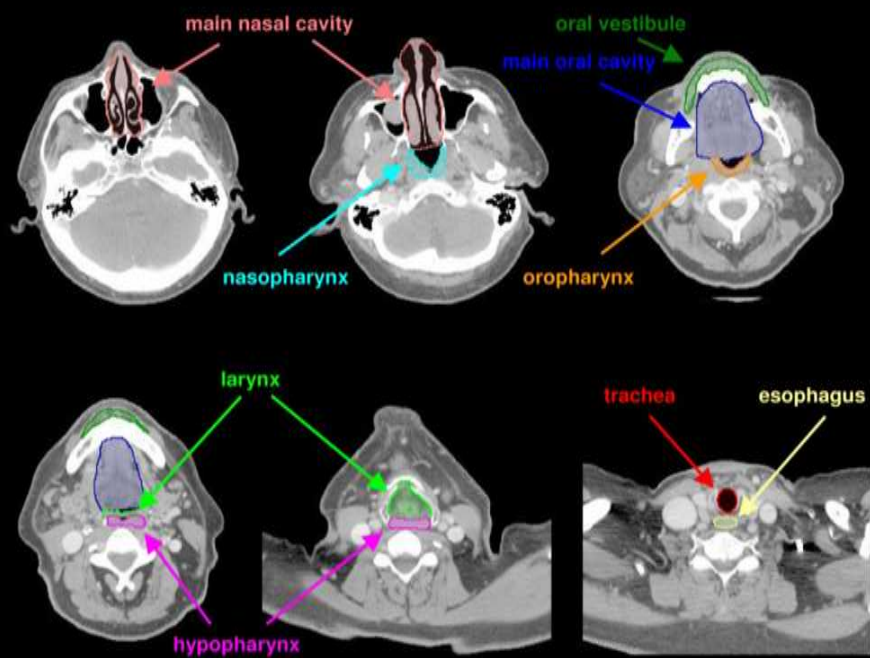
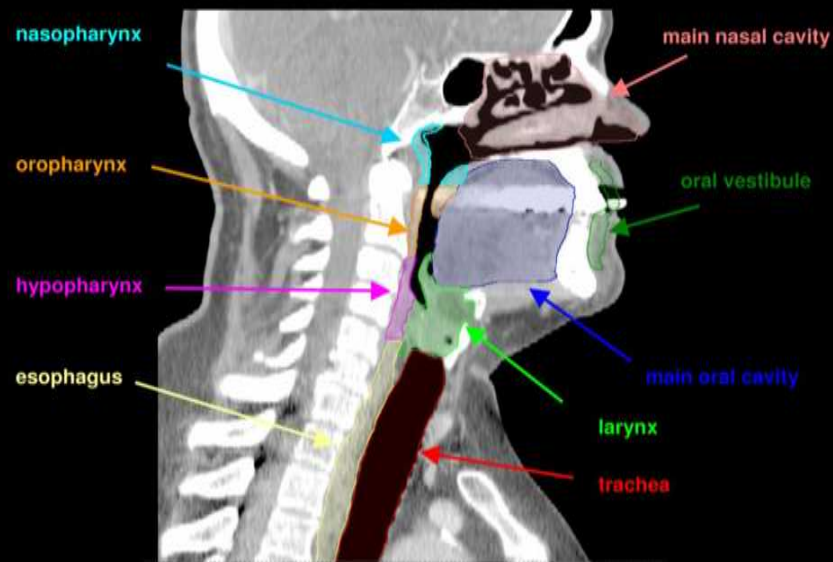


Figure 10 Coronal DIB with different lymph node regions, larynx and veins. The black circle symbolizes the jugular vein.

- Lnn. preauricular
- Lnn. infra-/intraparotidei
- Lnn. parotides superficiales
- Lnn. faciales
- Lnn. submentales (IA)
- Lnn. submandibulares (II)
- Lnn. retroauriculares
- Lnn. cervicales laterales superficiales
- Lnn. occipitales
- Lnn. cervicales posteriores profundi (VA)
- Lnn. ventrales jugulares superiores (IIA)
- Lnn. jugulares mediales (III)
- Lnn. jugulares inferiores (IV)
- Lnn. cervicales anteriores superficiales (VI)

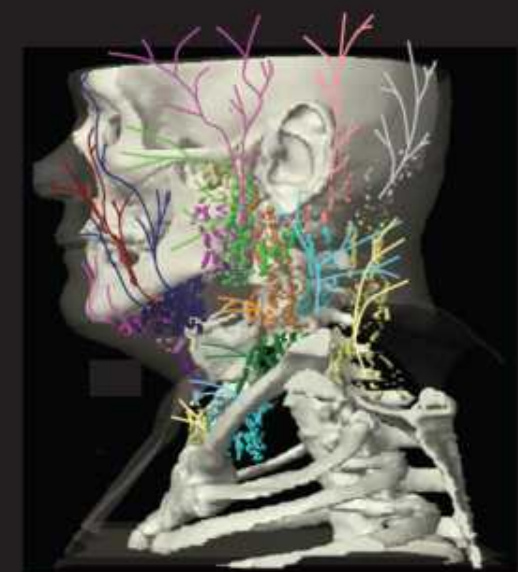


Figure 11 Lymph drain from the skin outlines as a schema on a capital view (for the systematic listing see Table 2): Lnn. preauriculares (low, cranial), Lnn. infra-/intraparotidei (light green), Lnn. parotides superficiales (pink, cranial), Lnn. faciales (brown), Lnn. submentales (IA, ventral), Lnn. submandibulares (dark blue), Lnn. retroauriculares (rose), Lnn. cervicales laterales superficiales (cyan cranio-dorsal), Lnn. occipitales (grey), Lnn. cervicales posteriores profundi (yellow, dorsal), Lnn. ventrales jugulares superiores (orange), Lnn. jugulares mediales (dark green), Lnn. jugulares inferiores (cyan, caudo-ventral), Lnn. cervicales anteriores superficiales (yellow, ventral).

Contornazione del tumore primitivo

- Le neoplasie del rinofaringe generalmente hanno origine dalla fossetta di Rosenmuller
- La diffusione locale della neoplasia può seguire 4 direzioni: anteriore, laterale, posteriore, inferiore
- Sia la TC che la RMN dovrebbero essere utilizzate per la definizione del tumore primitivo (GTV)
- CTV HD = GTV + 5-10 mm margini
- CTV HR = limiti anatomici standard
 - Anteriore: 1/3 posteriore delle cavità nasali – 1/3 posteriore dei seni mascellari – fosse pterigoidee
 - Posteriore: 1/3 posteriore del clivus, spazio retrostiloideo
 - Laterale: margini laterali dei processi stiloidei
 - Craniale: 1/2 inferiore del seno sfenoidale, 1/2 anteriore del clivus
 - Caudale: palato molle

Contornazione dei linfonodi

- Il drenaggio linfatico primitivo è rappresentato dai linfonodi retrofaringei, i linfonodi del livello II e dai linfonodi del livello Va
- Il drenaggio linfatico secondario è rappresentato dai linfonodi dei livelli III, IV e Vb
- Il livello Ib è coinvolto raramente
- Il drenaggio linfatico è bilaterale
- I linfonodi retrofaringei devono essere sempre inclusi nel CTV HR
- Nella contornazione dei linfonodi si dovrebbero risparmiare almeno 3 mm di derma in assenza di coinvolgimento della cute
- L'irradiazione completa dei linfonodi del collo è raccomandata anche in caso di N0



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CT-based delineation of lymph node levels and related CTVs in the node-negative neck: DAHANCA, EORTC, GORTEC, NCIC, RTOG consensus guidelines

Vincent Grégoire^{a,*}, Peter Levendag^{b,1}, Kian K. Ang^c, Jacques Bernier^d, Marijke Braaksma^b,
Volker Budach^e, Cliff Chao^c, Emmanuel Coche^f, Jay S. Cooper^c, Guy Cosnard^f,
Avraham Eisbruch^c, Samy El-Sayed^g, Bahman Emami^c, Cai Grau^h, Marc Hamoirⁱ,
Nancy Lee^c, Philippe Maingon^j, Karin Muller^b, Hervé Reyckler^k

^aRadiation Oncology Dept. and Laboratory of Radiobiology, Université Catholique de Louvain, St-Luc University Hospital, B-1200 Brussels, Belgium

^bRadiation Oncology Dept., Erasmus Medical Center Daniel den Hoed Cancer Center, Rotterdam, The Netherlands

^cHead and Neck group, RTOG, 1101 Market Street, 14th Floor, Philadelphia, PA 19107, USA

^dHead and Neck group, EORTC, Avenue E. Mounier, 83/11, B-1200 Brussels, Belgium

^eRadiotherapy group, EORTC, Avenue E. Mounier, 83/11, B-1200 Brussels, Belgium

^fRadiology Dept., Université Catholique de Louvain, St-Luc University Hospital, B-1200 Brussels, Belgium

^gHead and Neck DSG, NCIC-CTG, 10 Alcorn Avenue, Suite 200, Toronto, Ont., Canada, M4V 3B1

^hDAHANCA, Norrebrogade 44, 8000 Aarhus C, Denmark

ⁱHead and Neck Surgery Dept., Université Catholique de Louvain, St-Luc University Hospital, B-1200 Brussels, Belgium

^jGORTEC, Rue C. Desmoulins, 39, 94805, Villejuif, France

^kMaxillo-Facial Surgery Dept., Université Catholique de Louvain, St-Luc University Hospital, B-1200 Brussels, Belgium

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Table 1
Consensus guidelines for the radiological boundaries of the neck node levels

Level	Anatomical boundaries					
	Cranial	Caudal	Anterior	Posterior	Lateral	Medial
Ia	Geniohyoid m., plane tangent to basilar edge of mandible	Plane tangent to body of hyoid bone	Symphysis menti, platysma m.	Body of hyoid bone	Medial edge of ant. belly of digastric m.	n.a. ²
Ib	Mylohyoid m., cranial edge of submandibular gland	Plane through central part of hyoid bone	Symphysis menti, platysma m.	Posterior edge of submandibular gland	Basilar edge/innerside of mandible, platysma m., skin	Lateral edge of ant. belly of digastric m.
IIa	Caudal edge of lateral process of C1	Caudal edge of the body of hyoid bone	Post. edge of sub-mandibular gland; ant. edge of int. carotid artery; post. edge of post. belly of digastric m.	Post. border of int. jugular vein	Medial edge of sternocleidomastoid	Medial edge of int. carotid artery, paraspinal (levator scapulae) m.
IIb	Caudal edge of lateral process of C1	Caudal edge of the body of hyoid bone	Post. border of int. jugular vein	Post. border of the sternocleidomastoid m.	Medial edge of sternocleidomastoid	Medial edge of int. carotid artery, paraspinal (levator scapulae) m.
III	Caudal edge of the body of hyoid bone	Caudal edge of cricoid cartilage	Postero-lateral edge of the sternohyoid m.; ant. edge of sternocleidomastoid m.	Post. edge of the sternocleidomastoid m.	Medial edge of sternocleidomastoid	Int. edge of carotid artery, paraspinal (scalenus) m.
IV	Caudal edge of cricoid cartilage	2 cm cranial to sternoclavicular joint	Anteromedial edge of sternocleido-mastoid m	Post. edge of the sternocleidomastoid m.	Medial edge of sternocleidomastoid	Medial edge of internal carotid artery, paraspinal (scalenus) m.
V	Cranial edge of body of hyoid bone	CT slice encompassing the transverse cervical vessels ^b	Post. edge of the sternocleidomastoid m.	Ant-lateral border of the trapezius m.	Platysma m., skin	Paraspinal (levator scapulae, splenius capitis) m. n.a.
VI	Caudal edge of body of thyroid cartilage ^c	Sternal manubrium	Skin; platysma m.	Separation between trachea and esophagus ^d	Medial edges of thyroid gland, skin and ant-medial edge of sternocleidomastoid m.	Medial edge of the internal carotid artery
Retro-pharyngeal	Base of skull	Cranial edge of the body of hyoid bone	Fascia under the pharyngeal mucosa	Prevertebral m. (longus colli, longus capitis)	Medial edge of the internal carotid artery	Midline

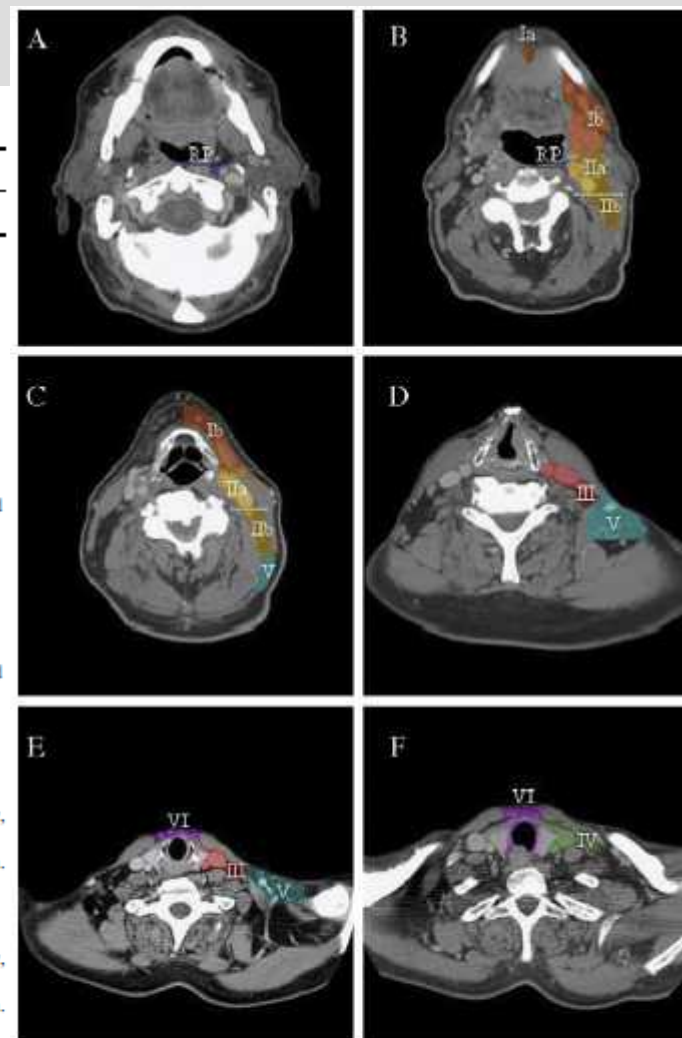


Fig. 2. CT imaging of a patient with a T1N0M0 glottic SCC (see tumor in panel D). The examination was performed on a dual-detector spiral CT (Elscent Twin, Haifa, Israel) using a slice thickness of 2.7 mm, an interval reconstruction of 2 mm and a pitch of 0.7. Contrast medium was injected intravenously at a rate of 2 ml/s with a total amount of 100 ml. Sections were taken at the level of the bottom edge of C1 (panel A), the upper edge of C3 (panel B), mid C4 (panel C), the bottom edge of C6 (panel D), the bottom edge of C7 (panel E), and mid D1 (panel F). Neck node levels were drawn on each CT slice using the radiological boundaries detailed in Table 1. Each node level corresponds to the CTV, and thus does not include any security margin for organ motion or set-up inaccuracy.

Guidelines for delineation of lymphatic clinical target volumes for high conformal radiotherapy: head and neck region

Hilke Vorwerk^{1,2*} and Clemens F Hess¹

Squamous cell cancer of the nasopharynx

The **lymphatic vessels** drain mainly to the LN retropharyngeales, level IIA and VA. Inconsistent channels can drain to the LN parotidales [6,30]. Squamous cell tumors of the nasopharynx show a very high rate of NM in 80% of the patients [7]. Even for N0 patients the incidence of NM in the bilateral level IIA, IIB, III, IV, VA and VB is high and should be included in the lymphatic CTV (Table 6) [6,7,39]. The lymph vessels in the retropharyngeal region are often crossing the sides. Accordingly the number of contralateral NM (30%) is very high in patients with nasopharyngeal cancer [6,7,35] and should be included in the lymphatic CTV.

nasopharynx

posterior wall of the pharynx beginning at the threshold between the soft and hard palatine up to the base of the skull

nasal surface of the soft palatine

palatine tonsil

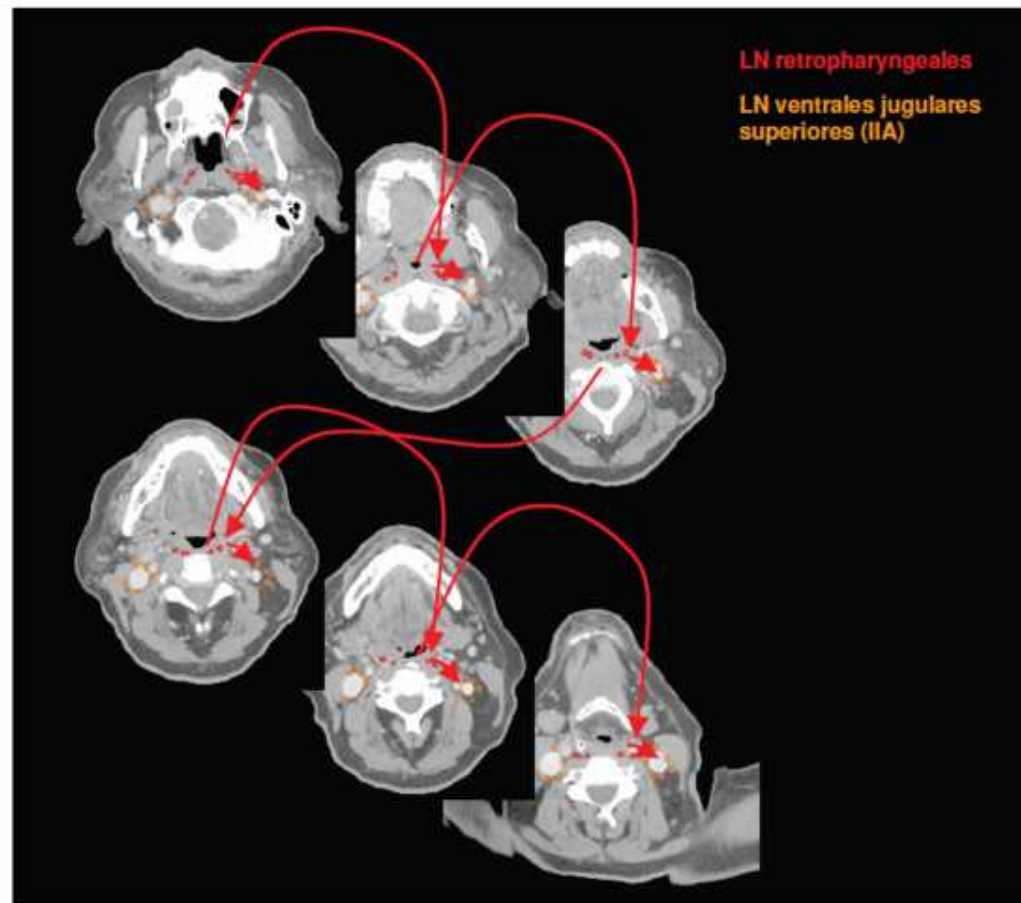


Figure 5 Lymph regions and drain contoured in transversal CT slices: LN retropharyngeales (red) [1 cm slice thickness].

nasopharynx

LN retropharyngeales

LN ventrales jugulares superiores
(crossing the sides!)

Linee guida per la contornazione bilaterale dei livelli del collo, risultati negativi all'imaging

Lato	Livello	Rischio	Osservazioni
Bilaterale	IB	Molto basso	Omettere; includere solo in caso di positività linfonodale
	Retrofaringei, II, III, Va	Alto	
	IV, Vb	Basso	Rischio più elevato quando è interessato il livello III

<i>OARs</i>	CRANIAL	CAUDAL	LATERAL	MEDIAL	ANTERIOR	POSTERIOR	CT WINDOW
COCHLEA	Petrous apex of temporal pyramid	Carotid canal	Medial wall of tympanic cavity	Temporal pyramid	Anterior and superior surface of petrous bone	Anterior aspect of internal auditory canal (IAC)	Bone C450 W1600



Fig. 2. Axial computed tomography image through the skull base. EAC = external acoustic canal; C = cochlea; V = vestibule; IAC = internal auditory canal.

The **cochlea** is a conical structure with its base resting anterior to the internal auditory canal and its apex pointed anteriorly, inferiorly, and laterally, toward the carotid artery. The vestibule is located posterior to the cochlea and lateral to the internal auditory canal. The internal auditory canal is a readily apparent landmark for identification of the cochlea and vestibule on CT (Figure 2). The volume of cochlea can be defined on axial CT images as the net volume defined by the bony labyrinth. In adults, the reported average volume of the cochlea using CT varies from 0.13 mL (range, 0.11–0.15 mL) (17) to 0.56 mL (range, 0.15–0.91 mL) (5).

<i>OARs</i>	CRANIAL	CAUDAL	LATERAL	MEDIAL	ANTERIOR	POSTERIOR	CT WINDOW
OPTIC BULB AND OPTIC NERVE	Superior rectus muscle; adipose tissue	Inferior rectus muscle; adipose tissue	Lateral rectus muscle; adipose tissue	Medial rectus muscle; adipose tissue	/	Retrobulbar adipose tissue; Optic foramen	H&N C35 W350 Bone C450W1600 (per tratto intracanalare del nervo)
OPTIC CHIASM	0,5 cm above anterior clinoid processes	Cavum sellae	Medial surface of uncus hippocampi; temporal horn of the lateral ventricle	/	Line through the anterior clinoid processes	Mesencephalon (anterior aspect of cerebral peduncol); posterior clinoid included	Brain C35 W100 Bone C450W1600

The optic nerves progress from the posterior aspect of the center of the globe roughly through the center of the orbit, bracketed by the rectus muscles. They angle up through the optic canals just medial to the anterior clinoid process of the lesser wings of the sphenoid bone. The axonal bundles of the left and right optic nerves, divide at the optic chiasm.

The medial fibers cross to the contralateral optic tract, and the lateral fibers continue on the ipsilateral tract. The optic chiasm forms an X shape at this junction. Typically, it is just superior to the sella turcica, with the nerves crossing just anterior to the pituitary stalk. It is bracketed laterally by the internal carotid arteries and is inferior to the third ventricle (10–12). With conventional computed tomography or magnetic resonance imaging, the optic tracts are visible for only 1–2 cm posterior to the optic chiasm before the fibers spread and appear to blend into the rest of the brain parenchyma.

OARs	CRANIAL	CAUDAL	LATERAL	MEDIAL	ANTERIOR	POSTERIOR	CT WINDOW
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PAROTID	Inferior edge of external auditory canal	Inferior margin of mandibular branch	Subcutaneous adipose tissue	longus capitis muscle and internal pterygoidei muscle	Posterior border of the masseter muscle (clavicular branch), mandibular posterior corner	Sternocleidomastoid muscle	H&N C35 W350
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Parotid and submandibular salivary glands can be adequately delineated on contrast-enhanced computed tomography images. However, irradiated parotid glands typically shrink during RT, presumably owing to cell loss. On the basis of weekly computed tomography scans of 15 patients, Robar *et al.* (11) reported little change in the medial parotid gland position during RT. However, the lateral edges shrank, on average, ≈ 1 mm/wk during RT (average displacements of 4–6 mm during the RT course), resulting in decreasing gland sparing

<i>OARs</i>	CRANIAL	CAUDAL	LATERAL	MEDIAL	ANTERIOR	POSTERIOR	CT WINDOW
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SUPERIOR PHARYNGEAL CONstrictor MUSCLE	Occipital condyle	Superior edge of hyoid bone	Palatine tonsil or parapharyngeal space	Pharynx	Pterygoidei muscle: anterior margin	Longus capitis muscle	H&N C35 W350
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MIDDLE PHARYNGEAL CONstrictor MUSCLE	0,5 cm above hyoid bone	Inferior edge of the hyoid bone	Palatine tonsil or parapharyngeal space	Pharynx	Oropharynx, lateral edge of hyoid bone	Longus capitis muscle	H&N C35 W350
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INFERIOR PHARYNGEAL CONstrictor MUSCLE	Inferior edge of the hyoid bone	Esophagus	Parapharyngeal space, lateral edge of thyroid	Pharynx	Arytenoid, first tracheal ring	Longus capitis muscle; anterior vertebral body	H&N C35 W350
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