
# Head and Neck Intensity Modulated Radiation Treatment: dysphagia after Constrictors Muscles definition

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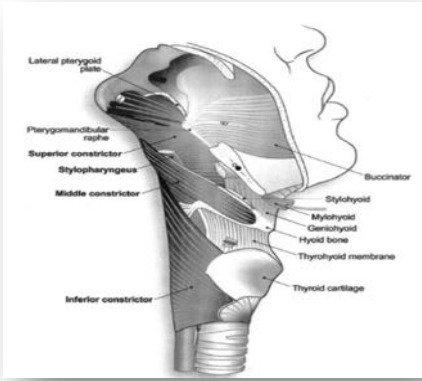
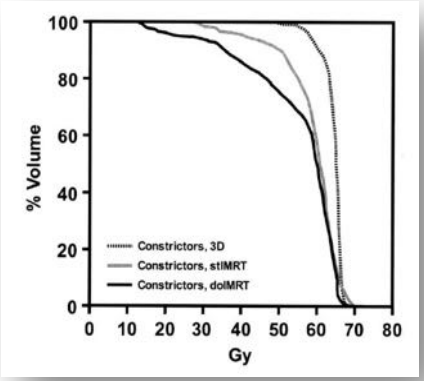
# *Background*


**DYSPHAGIA AND ASPIRATION AFTER CHEMORADIOTHERAPY FOR HEAD-AND-NECK CANCER: WHICH ANATOMIC STRUCTURES ARE AFFECTED AND CAN THEY BE SPARED BY IMRT?**

**Radiation damage to the *Pharyngeal Constrictors* and the glottic/supraglottic larynx were implicated in post-radiotherapy *dysphagia***




***IMRT* can reduce the volumes of these structures receiving high doses, and incorporating the goal of *sparing* these structures into the optimization cost function can achieve significant additional benefit**



Eisbruch A. et al. Int J Radiat Oncol Biol Phys, 2004

# *Background*

Studies assessing dose-volume analyses for late dysphagia

| Author | Pts | Site | Dosimetric Factors correlated with late dysphagia | Limits | Anatomic Borders | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | SPC | MPC | IPC | Crico |
| Feng[34] (2007) | 36 | OP/NP | PCs (mean dose, V50, V60, V65) | Cranial | Caudal tips of pterygoid plates | Upper edge of hyoid bone | Below the hyoid bone | Not Mentioned |
| | | | | Caudal | Upper edge hyoid bone | Lower edge of the hyoid bone | Inferior edge of cricoid | |
| Levendag[21] (2007) | 56 | OP | SPC, MPC (mean dose) | Cranial | Mild C2 | Upper C3 | Upper C5 | Mild C6 |
| | | | | Caudal | Upper C3 | Upper C4 | Mid C6 | First ring of trachea |
| Jensen[35] (2007) | 25 | PH | SL (mean dose, V60, V65) | Cranial | Lower part transverse process C2 | Lower part transverse process C2 | Lower part transverse process C2 | Not Mentioned |
| | | | | Caudal | Top of cricoid cartilage | Top of cricoid cartilage | Top of cricoid cartilage | |
| Caglar[29] (2008) | 96 | M | IPC (mean dose, V50, V60) | Cranial | Pterygoid plates | Upper edge of hyoid bone | Inferior edge hyoid bone | Not Mentioned |
| | | | | Caudal | Upper edge ofthe hyoid bone | Lower edge of the hyoid bone | Lower edge cricoid | |
| Dirix[30] (2009) | 53 | M | MPC (mean dose,V50) | Cranial | Caudal tip of the pterygoid plates | Upper edge of hyoid bone | Inferior edge hyoid bone | Lower edge cricoid |
| | | | | Caudal | Upper edge hyioid bone | Lower edge of the hyoid bone | Lower edge cricoid | Upper edge of trachea |
| Bhide[31] (2009) | 37 | M | No correlations | Cranial | Base of the skull | Superior end of hyoid bone | Inferior edge hyoid bone | Not Mentioned |
| | | | | Caudal | Superior end hyoid bone | Caudal end of the cartilage cricoid | Lower edge cricoid | |
| Caudell[36] (2010) | 83 | M | IPC (V60, V65) | Cranial | Pterygoid plates | Upper edge of hyoid bone | Inferior edge hyoid bone | Not Mentioned |
| | | | | Caudal | Upper edge of the hyoid bone | Lower edgem of the hyoid bone | Lower edge cricoid | |
| Mortensen[32] (2013) | 65 | M | SPC, MPC (mean dose) | Cranial | Caudal tip of the pterygoid plates | Upper edge of C3 | First slice caudal to the lower edge of hyoid bone | First slice caudal to the arytenoid cartilages |
| | | | | Caudal | Lower edge of C2 | Lower edge of hyoid bone | Lower edge of the arythenoid cartilages | Lower edge of the cricoid cartilages |

OP: Oropharynx NP: Nasopharynx PH: Pharynx M: Miscellaneous, PCs: All constrictors. C2: 2nd cervical vertebra, C3: 3th cervical vertebra, C4: 4th cervical vertebra, C5: 5th cervical vertebra, C6: 6th cervical vertebra

PCS: Pharyngeal constrictor muscle, SPC: Superior constrictor muscle, MPC: Middle constrictor muscle, SL: Supraglottic larynx, IPC: Inferior constrictor mucle,V50=volume of a structure receiving 50 Gy. V60=volume of a structure receiving 60 Gy. V65=volume of a structure receiving 65 Gy D60=minimum dose received by 60% of a structure. V70=volume of a structure receiving 70 Gy Dmax: Dose maximum

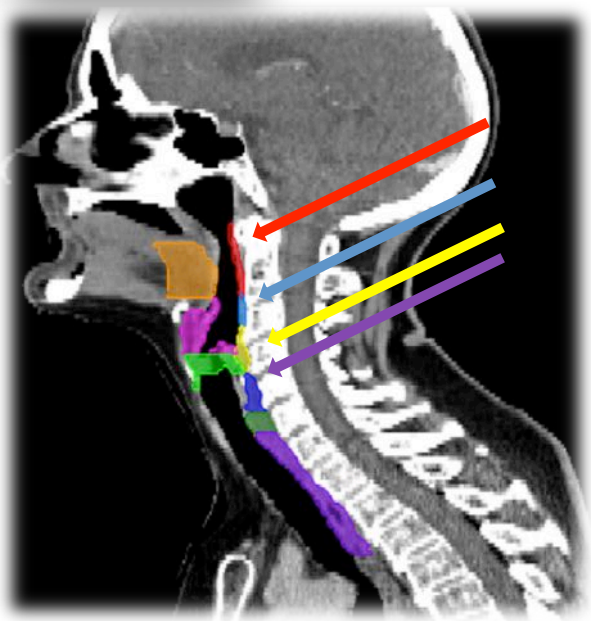


Adapted from: Mazzola R. et al. BJR, 2014

# *Background*


## Delineation of organs at risk involved in swallowing for radiotherapy treatment planning

Miranda E.M.C. Christianen [a], Johannes A. Langendijk [a,*], Henriëtte E. Westerlaan [b], Tara A. van de Water [a], Hendrik P. Bijl [a]

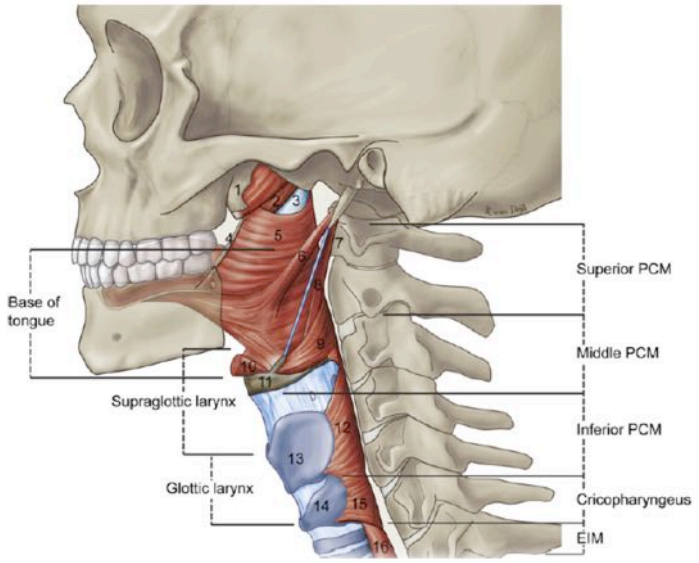


**PCMs: Superior (Red); Middle (Light Blue); Inferior (Yellow); Cricopharyngeus (Dark Blue)**

| Muscle | Cranial | Caudal | Anterior | Posterior | Lateral | Medial |
|---|---|---|---|---|---|---|
| Superior PCM | Caudal tip of the pterygoid plates (hamulus) | Lower edge of C2 | Hamulus of pterygoid plate; mandibula; base of tongue; pharyngeal lumen | Prevertebral muscle | Medial pterygoid muscle | Pharyngeal lumen |
| Middle PCM | Upper edge of C3 | Lower edge of hyoid bone | Base of tongue; hyoid bone | Prevertebral muscle | Greater horn of hyoid bone | Pharyngeal lumen |
| Inferior PCM | First slice caudal to the lower edge of hyoid bone | Lower edge of the arythenoid cartilages | Soft tissue of supraglottic/glottic larynx | Prevertebral muscle | Superior horn of thyroid cartilage | Pharyngeal lumen |
| Cricopharyngeal muscle | First slice caudal to the arytenoid cartilages | Lower edge of the cricoid cartilages | Posterior edge of cricoid cartilage | Prevertebral muscle | Thyroid cartilage, fatty tissue, thyroid gland | |

# *Study Design and Methods*

*Dose–Volume Analysis and* **observed incidence of acute and late** *dysphagia* **in HNC-***IMRT* **after** *re-contouring* **of PCMs and cricopharyngeal muscle according to** *Christianen M.E.* **guidelines**

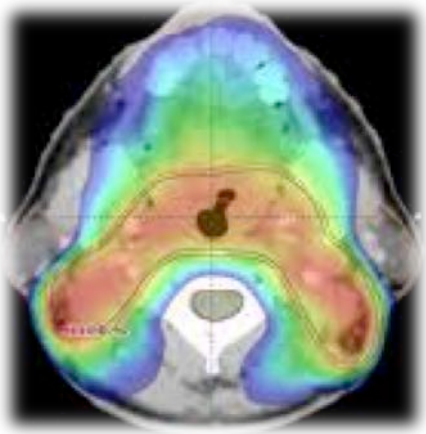



**On planning CT scan, the** *PCs* **and** *cricopharyngeal muscles* **were retrospectively contoured by a** *single observer* **and subsequently reviewed by** *another radiation oncologist*

# *Patients and Treatment*

Patients characteristics (n= 56)

| Factors | Description | |
|---|---|---|
| Gender | Male | 77% (n=43) |
| | Female | 23% (n=13) |
| Age | Median 64 y | Range[24 - 86] |
| Smokers | Yes | 77% (n=43) |
| | No | 23% (n=13) |
| Diabetic | Yes | 5% (n=3) |
| | No | 95% (n=53) |
| Primary Site | Rinopharynx | 9% (n=5) |
| | Oropharynx | 30% (n=17) |
| | Oral Cavity | 18% (n=10) |
| | Larinx Sovraglottic | 9% (n=5) |
| | Larinx Glottic | 30% (n=17) |
| | Salivary Glands | 4% (n=2) |
| Histology | Epidemoidal | 88% (n=49) |
| | Others | 12%(n=7) |
| Grading | G1 | 27% (n=15) |
| | G2 | 46% (n=26) |
| | G3 | 27% (n=15) |
| Stage | I | 20% (n=11) |
| | II | 12% (n=7) |
| | III | 18% (n=10) |
| | IVA | 46% (n=26) |
| | IVB | 4% (n=2) |
| Chemiotherapy | Cisplatino weekly | 20% (n=11) |
| | Cisplatino 3-weekly | 32% (n=18) |
| | Induction | 2% (n=1) |
| | None | 46% (n=26) |
| Radiotherapy | Radical | 71% (n=40) |
| | Adjuvant | 29% (n=16) |



**<u>Radical setting</u>:**
- 70 Gy (33-35 fr) PTV(T)
- 59.94 - 63 Gy PTV(HR)
- 54.45 - 58.1 Gy PTV(LR)

**<u>Postoperative setting</u>:**
- 60 Gy Surgical Bed
- 54 Gy Nodes

**Cisplatin 100 mg/m2 q21:**
- ECOG – PS 0-1
- Age ≤ 70 y
- Locally advanced

**Cisplatin 30 mg/m2 qw:**
- ECOG - PS 2
- Age ≤ 70 y
- Locally advanced

# *Toxicity Evaluation*

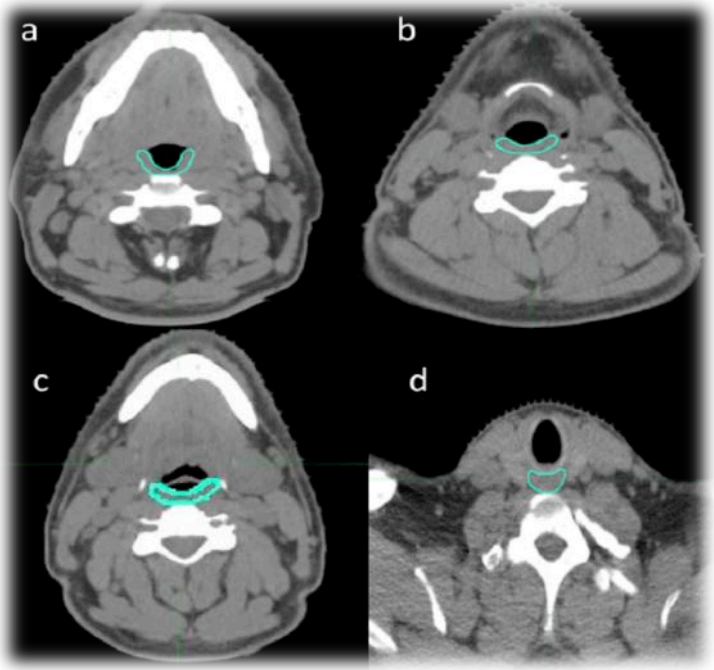
*1) EORTC/RTOG radiation morbidity score system*

*2) No baseline dysphagia*

*3)* **Toxicity evaluation weekly during RT**

**Acute toxicity** → **within 90 days from RT**

**Late toxicity** → **after 90 days from RT**




**a-d: Definition of Constrictors and Cricopharyngeal muscles in axial CT planning slice**

*Dosimetric Parameters* **for each structure were related to** *acute* **and** *late* **toxicity**

# *Results*


## Dose–volume-related dysphagia after constrictor muscles definition in head and neck cancer intensity-modulated radiation treatment

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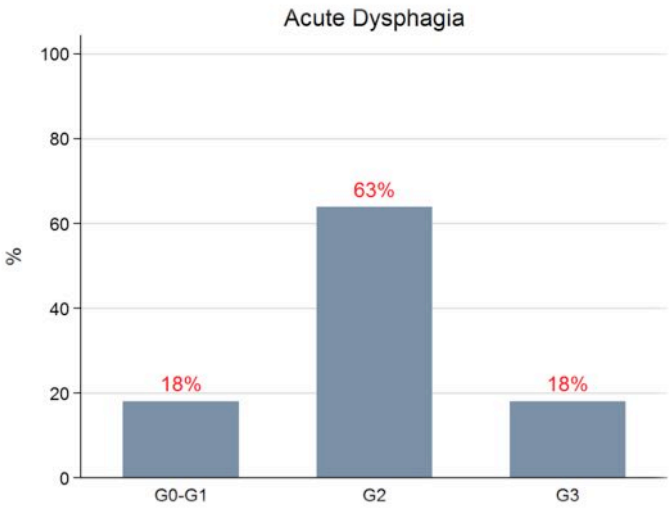


*Acute Dysphagia* ≥ *G2*

- *Superior PC* → No correlation
- *Middle PC* → *Dmean* ≥ 50 Gy ($p < .05$); *V50* ≥ 70 ($p < .01$)
- *Inferior PC* → No correlation
- *Crico* → *Dmax* > 60 Gy ($p < .05$)

# *Results*


## Dose–volume-related dysphagia after constrictor muscles definition in head and neck cancer intensity-modulated radiation treatment

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*Late Dysphagia ≥ G2*

- *Superior PC* → *Dmean* ≥ 50 Gy ($p < .01$); *Dmax* > 60 Gy ($p < .05$); *V50* ≥ 70 ($p < .01$) [*6-9 months*]
- *Middle PC* → *Dmean* ≥ 50 Gy ($p < .01$); *Dmax* > 60 Gy ($p < .05$); *V50* ≥ 70 ($p < .01$) [*6 months*]
- *Inferior PC* → No correlation
- *Crico* → No correlation

*No statistical correlation at 12 and 24 months*

# *Correlation with clinical factors…*

- *Oropharynx primary site ($p < .05$)* → *Acute/Late Dysphagia*
- **Late Xerostomia ≥ G2 ($p < .05$)** → **Late Dysphagia ≥ G2 ($p < .05$)**


**Organ sparing and clinical outcome with step-and-shoot IMRT for head and neck cancer: a mono-institutional experience**

Rosario Mazzola · Giuseppe Ferrera · Filippo Alongi · Mariella Mannino · Boris Abbate · Teresa Cucchiara · Giuseppina Iacoviello · Francesco Sciumè · Gioacchino Di Paola · Manuela Federico · Livio Blasi · Antonio Lo Casto · Roberto Lagalla · Domenico Messana

*Xerostomia causes alterations in speech/taste and difficulties in the swallowing process with strong correlation with dysphagia-related qualiy of life*

# *Conclusion*

*Based on Christianen guidelines, dose constraints to superior and middle PCs seem to play a role as dosimetric predictors of acute/late swallowing disorders*

*Findings of the present study are influenced by several limitations*

Associazione Italiana Radioterapia Oncologica

*Valutazione strumentale della disfagia tardiva in pazienti affetti da neoplasia del Rinofaringe e Orofaringe candidati a trattamento radiochemioterapico concomitante con tecnica IMRT*

*THANKS FOR ATTENTION!*

Ospedale Sacro Cuore - Don Calabria Negrar (Verona)