Guidelines for the delineation of the primary tumour Clinical Target Volumes (CTV) in laryngeal, hypopharyngeal, oropharyngeal and oral cavity SCC (version 5.1)

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Target volumes in Radiation Oncology: ICRU definition

- Gross Tumor Volume: GTV
- Clinical Target Volume: CTV
- Planning Target Volume: PTV
- Organ at Risk (OAR)
- Planning Organ at Risk Volume (PRV)
T2 N1 M0 Tonsil Cancer

Primary Tumor

Neck Node

Harari et al., 2004 & 2012
H&N IMRT practice heterogeneity

Harari et al., 2004 & 2012
Delineation of the neck node levels for head and neck tumors: A 2013 update. DAHANCA, EORTC, HKNPCSG, NCIC CTG, NCRI, RTOG, TROG consensus guidelines ☆

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Primary Tumor Target Volumes (GTV and CTV)
Clinical Target Volume (CTV) for pharyngo-laryngeal SCC

Anatomical margins
**GTV:** Macroscopic tumor in T and N position, based on all available information.

**CTV1:** Includes GTV-T and GTV-N with a concentric margin of *5 mm in all directions*, modified for air and bone. Larger margin if ill-defined tumor.

**CTV2:** Includes CTV1 and the volume surrounding CTV1 with the highest risk of subclinical spread; CTV1 with a *concentric margin of 5 mm* in all directions, modified for air and bone.

**CTV3:** CTV2 and the elective nodal regions
In N+ also include nodal areas at least *

2 cm cranial and caudal to GTV-N*, and if invading muscle, include muscle at least *2 cm cranial and caudal to GTV-N.*

Courtesy of C. Grau, 2016
<table>
<thead>
<tr>
<th>Parameter</th>
<th>2004</th>
<th>STD</th>
<th>CV</th>
<th>2013</th>
<th>STD</th>
<th>CV</th>
<th>Change %</th>
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<tbody>
<tr>
<td>CTV1 cm³</td>
<td>74</td>
<td>78</td>
<td>105%</td>
<td>104</td>
<td>9</td>
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<td>40%</td>
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<tr>
<td>CTV2 cm³</td>
<td>144</td>
<td>50</td>
<td>35%</td>
<td>190</td>
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<td>4%</td>
<td>32%</td>
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<tr>
<td>CTV3 cm³</td>
<td>254</td>
<td>47</td>
<td>19%</td>
<td>291</td>
<td>18</td>
<td>6%</td>
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<tr>
<td>PTV1 i cm³</td>
<td>169</td>
<td>105</td>
<td>62%</td>
<td>229</td>
<td>32</td>
<td>14%</td>
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<td>PTV2 i cm³</td>
<td>279</td>
<td>63</td>
<td>23%</td>
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<td>PTV3 i cm³</td>
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<td>567</td>
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<td>V70.6 Gy cm³</td>
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<td>-</td>
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<td>V62.7 Gy cm³</td>
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<td>50%</td>
<td>267</td>
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<td>V57.0 Gy cm³</td>
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<td>398</td>
<td>36</td>
<td>9%</td>
<td>10%</td>
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<td>V47.5 Gy cm³</td>
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<td>823</td>
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<td>V40.0 Gy cm³</td>
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<td>17%</td>
<td>1161</td>
<td>228</td>
<td>20%</td>
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<td>V30.0 Gy cm³</td>
<td>1403</td>
<td>230</td>
<td>16%</td>
<td>1591</td>
<td>350</td>
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<td>Max dose Spinal Cord Gy</td>
<td>42</td>
<td>2</td>
<td>5%</td>
<td>43</td>
<td>3</td>
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<td>Mean dose left parotid Gy</td>
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<td>5</td>
<td>12%</td>
<td>46</td>
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<td>7%</td>
<td>10%</td>
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<tr>
<td>Mean dose right parotid Gy</td>
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<td>6</td>
<td>22%</td>
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<td>5%</td>
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<td>Max dose Mandible Gy</td>
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<td>1%</td>
<td>67</td>
<td>1</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>
Margins around the primary tumor GTV

Two non-exclusive “schools”

• **Anatomical margins:**
  - Defined by anatomical borders, and based on ”knowledge” on the typical extension pattern of the primary tumor

• **Geometrical margins:**
  - Addition of a concentric margin around the GTV, which are modified for natural borders (bone, air)
Of 88 slides from 10 patients with oral cancers, 44 (50%) had signs of microscopic extension. The maximum distance from the border was 7.8 mm. Ninety-nine percent of all MD was within 4.75 mm and 95% was within 3.95 mm of the GTV.
Out of 21 specimens analyzed, the probability of microscopic tumor infiltration beyond the 5-mm margin from the GTV boundary was less than 5%.
From primary tumor GTV to CTV
Geometrical/anatomical margins from surgical series

Annals of Otology, Rhinology & Laryngology

Analysis of Recurrences in 322 TIS, T1, or T2 Glottic Carcinomas Treated by Carbon Dioxide Laser

Giorgio Peretti, MD, Andrea Bolzoni, MD, Giovanni Parrinello, PhD, Maria C. Mensi, MD, Stanley M. Shapshay, MD, Cesare Piazza, MD, Manuela Rossini, MD, Antonino R. Antonelli, MD

First Published November 1, 2004 | research-article
From GTV to CTV-T delineation

General procedure

• Acquisition of a planning CT with iv contrast
• Accurate delineation of the GTV-T
  - Clinical examination including fiberoptic
  - Endoscopic examination with drawings/pictures
  - Diagnostic CT/MRI/FDG-PET
From GTV to CTV-T delineation

Nomenclature

- **GTV-T**
- **CTV-T1**: GTV-T + 5 mm + editing / highest dose prescription
- **CTV-T2**: GTV-T + 10 mm + editing / prophylactic or intermediate dose prescription
From GTV to CTV-T delineation

Primary tumor CTV:

- Addition of a concentric margin around the GTV, including head & neck compartments (e.g. pre-epiglottic space, parapharyngeal space), modified for natural borders (e.g. cartilage, bone, air, muscular fascia) unless invaded
- Elective CTV: GTV + 1 cm (1.5 cm of mucosal extension for hypopharyngeal SCC)
- High dose CTV: GTV + 0.5 cm
From primary tumor GTV to CTV

The anatomy-based edition of the “5+5 mm” geometrical margins

- Edition for air cavities
- Edition for anatomy
- Edition for barriers
- Edition based on experience in endoscopic surgery
From GTV to CTV-T delineation

A word of caution

- PTV delineation required
- Primary radiotherapy and not post-operative radiotherapy
- SCC p16- and p16+
- Oral cavity, pharynx and larynx
- Not valid for recurrent tumors
- Not valid in case of missing information
From GTV to CTV-T delineation

And for nasopharyngeal carcinoma?

Anne Lee (Hong Kong) and Joseph Wee (Singapore) are coordinating the effort for CTV delineation guidelines for NPC.
From primary tumor GTV to CTV
T2 supra-glottic SCC

Tunis
March 2017
From primary tumor GTV to CTV
T2 piriform sinus SCC
From primary tumor GTV to CTV
T1 base of tongue SCC
From primary tumor GTV to CTV
T3 oropharyngeal SCC
From primary tumor GTV to CTV
T4b oropharyngeal SCC
From primary tumor GTV to CTV
T4 oral cavity SCC
From primary tumor GTV to CTV

T2 glottic SCC

CTV-T = GTV + 5mm
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