Target Delineation
For Head and Neck Cancer

Nasopharyngeal and Oropharyngeal CA

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Delineation of the Gross Target Volume or GTV
Two Issues

• Issue of Using IV contrast?
  – Contrast Density: ? Dose Calculation
  – Amount of contrast needs adjustment?
  – At MSKCC, routine use of IV contrast at simulation

• How about Image Fusion?
  – MRI: Head & Neck don’t match
  – PET: What is the right window level?
CT vs. MRI vs. PET volume

Thiagarajan A. et al. ASTRO 2010

Final GTV

Importance of Physical Examination
Added Value of MRI:
Particularly for the skull base
All NPC patients need MRI unless medically contraindicated.

T1 weighted Image Without Contrast

T1 disease changed to T3 disease
Current MSKCC Dose Painting Guidelines

**Gross Disease**

\[ PTV_{70} : \ 70 \text{ Gy over 33 Days (2.12 Gy)} \]

**High Risk Subclinical**

\[ PTV_{59.4} : \ 59.4 \text{ Gy over 33 Days (1.8 Gy)} \]

**Lower Risk Subclinical**

\[ PTV_{54} : \ 54 \text{ Gy over 33 Days (1.64 Gy)} \]
GTV\textsubscript{70} to PTV\textsubscript{70}

GTV: Gross tumor based on imaging, PE

GTV is also known as CTV\textsubscript{70}

PTV\textsubscript{70}: GTV + 3-5mm (based on you comfort level)
Primary and nodal GTV$_{70}$

PTV$_{70}$: GTV$_{70}$ + 3mm Margin

T2N2C BOT
IMRT
Head and Neck Cancer
CTV Delineation

Knowledge of Patterns of Spread
RTOG, EORTC, DAHANCA
N0 and non-surgically violated neck nodal
atlas: www.rtog.org

No Other Consensus
Nasopharynx (Primary): CTV_{59.4} Delineation

- Sphenoid Sinus
- Cavernous Sinus
- Skull base
- Clivus
- posterior 1/3 maxillary sinus (pterygopalatine fossae where 2 resides)
- Posterior 1/3 of nasal cavity
- parapharyngeal space (where 3 resides)
- retropharyngeal space
- Inferiorly Soft Palate
Anterior Coverage Post 1/3 of Max Sinus Nasal Cavity

CTV_{59.4}

Pterygoid Fossae Parapharyngeal Fat

GTV

Skull Base Clivus Sphenoid Sinus

Retropharyngeal Lymph Nodal Region

T2
Coverage of Sphenoid Sinus, Cavernous Sinus

$CTV_{59.4}$

$PTV_{59.4}$

CTV$\textsubscript{59.4} + 3\text{mm} = PTV_{59.4}$

$PTV_{70}$
Coverage of Skull base
Pterygopalatine Fossae

$PTV_{70}$
Coverage of Parapharyngeal Fat

PTV_{70}
Nasopharynx (Nodal): \( CTV_{59.4} \) Delineation

- Retrostyloid space
- Bilateral levels Ib through V
- Level Ib can be omitted in node negative disease
Coverage of Retrostyloid Space Regardless of N stage for NPC
Coverage of level V
Level V Nodal Coverage

High Risk PTV

Low Risk PTV
If choosing to use beam Split technique, Make sure use AP/PA with midline block For all NPC cases as nodes can spread posteriorly
Oropharynx (Primary) CTV$_{59.4}$ Delineation

- Should probably have at least 1cm circumferential margin except near bony region, especially there are no good salvage options for failure.

- Base of tongue cancer to include pre-epiglottic fat and entire base of tongue (but can be in the next lower dose region).

- Tonsil cancer, should include the pterygoid plate (ensuring good coverage superiorly of pterygoid mandibular raphe).
Ensuring Coverage of Pre-epiglottic space
Look at the growth pattern of your cases to determine CTV\textsubscript{59.4} coverage.

Need to Include Pterygoid Plate
Oropharynx (Nodal): CTV\textsubscript{59.4} Delineation

- **Node+**: levels IB-V

- Can consider shrinking volume, just treat levels Ib-IV or II-IV in node positive cases

- **Node negative**: levels II-IV

- At MSKCC, we no longer perform routine planned neck dissection. IMRT with precise targeting of the gross neck nodes has changed practice
CTV low neck
For oropharynx CA
Not treating level V

CTV_{54}

CTV_{59.4}
Base of Tongue CA

PTV$_{70}$

CTV$_{59.4}$

PTV$_{59.4}$
Example Stage IVB oropharynx CA

Superior to Inferior slices

Treat Bilateral Retrostyloid Spaces
No actively trying to spare Constrictor muscles

Distance from GTV To PTV59.4 is at least 1.3 cm
Coverage of pre-epiglottic fat but spare larynx

Even with N+, level V not included
Node--: $CTV_{54}$ Delineation

- Levels II-IV

- Coverage of the retropharyngeal region.

- For oropharyngeal CA, when posterior belly of digastric just crosses IJ, can omit treating high level II, i.e, only target subdigastric nodes. (Omitting the retrostyloid space)

- $CTV_{54} + 3\text{mm} = PTV_{54}$
Omit high levels IIA/IIB

N- Neck Typically around C2
PTV 54 Gy

PTV 59.4 Gy

PTV 70 Gy

N- Contralateral Neck Can Spare the high IIA/IIB nodes
Coverage of Retropharyngeal Region Bilaterally But omitting contralateral Retrostyloid space
Retropharyngeal Space

**N+**

**N-**

Lymphatic drainage of pharynx: posterior view
Contour at RP nodal level for bilateral N+ neck
Superior Aspect of Nodal CTV for Contralateral N0 Neck

MSKCC

U Michigan

MDACC

C1

Courtesy of Q Le, ASTRO Practicum 2008
Can We further Dose Paint?

Even a lower risk microscopic region!
Perhaps we should have CTV$_{50}$
PTV_{50}

BED calculation is 57.6 for tumoricial effect.

BED for 44 Gy at 2 Gy per fraction: 52.8

BED for 50 Gy at 2 Gy per fraction: 60
IMRT for NPC: UCSF

(UCSF, Lee et al, IJROBP, 53:1:12-21)

- N = 87

- PTVg = 70 Gy @ 2.12 Gy concurrently
  PTVm = 59.4 Gy @ 1.8 Gy per day

- T3/T4: 45%
  III/IV: 74%

- N+: 79%

- Chemotherapy: 85%
4 Year Local Progression-free

% Local PF Rate

N=87
Median F/U=30 months

97%
Stage: I-IVb
Histology: WHO I-III

70 Gy to gross disease concurrently
59.4 Gy to microscopic disease
Over 33 days

CT: (≥ T2b and/or + LN)
Local Progression-Free Interval

- 3 year: 92.6% (34% T3/4)
- 1 local failure only
- 3 local regional failures

Lee et al, JCO, 2009
Regional Progression-Free Interval

- 3 year: 90.8% (43% N2/3)
- 2 regional failures only
- 5 local and regional failures

Lee et al, JCO, 2009
IMRT for Oropharynx: Patients Population

From 9/1998 to 4/2009 442 patients treated with IMRT for OPC (SCC, M0)

Site:
- Tonsil: 50%
- Base of Tongue: 46%
- Soft Palate: 2%
- Pharyngeal wall: 2%

Stage:
- T2: 42%, T3: 18%, T4: 14%
- N1: 21%, N2: 67%, N3: 3%

Stage III: 19%, Stage IV: 76% (91% received chemotherapy)

Setton et al. IJROBP Submitted
Oropharyngeal Ca: IMRT (n=445)
Local Control

3-year 94.4%
5-year 94.4%

Median FU 36.8 months
Regional Control

- 3-year: 94.3%
- 5-year: 94.3%
## OS, DMFS and Statistics

### OS:
- 3 years: 84.9%
- 5 years: 78.7%

### DMFS:
- 3 years: 87.1%
- 5 years: 85.2%

<table>
<thead>
<tr>
<th>Univariate (Logrank)</th>
<th>Multivariate (Cox)</th>
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<tbody>
<tr>
<td>T1/2 vs T3/4</td>
<td>T1/2 vs T3/4</td>
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<tr>
<td>N0/1 vs N2/3</td>
<td>N0/1 vs N2/3</td>
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NS: Site, Age, Treatment Modality, Histology
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<th>Year</th>
<th># of Pt</th>
<th>Median FU (mo)</th>
<th>Definitive (%)</th>
<th>Stage III-IV (%)</th>
<th>Chemo (%)</th>
<th>Local and/or Regional Control</th>
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<td>95</td>
<td>91</td>
<td>LF: 5 RF: 6 (3)</td>
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Conclusion

• As we enter the era of such high precision radiotherapy treatment for our patients, it is **CRUCIAL** that our targets and normal tissues are drawn accurately.

• Remember that the best chance for cure is the first chance.

• Study each failure carefully!