

Target Delineation

For Head and Neck Cancer

Nasopharyngeal and Oropharyngeal CA

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Delineation of the Gross Target Volume or GTV

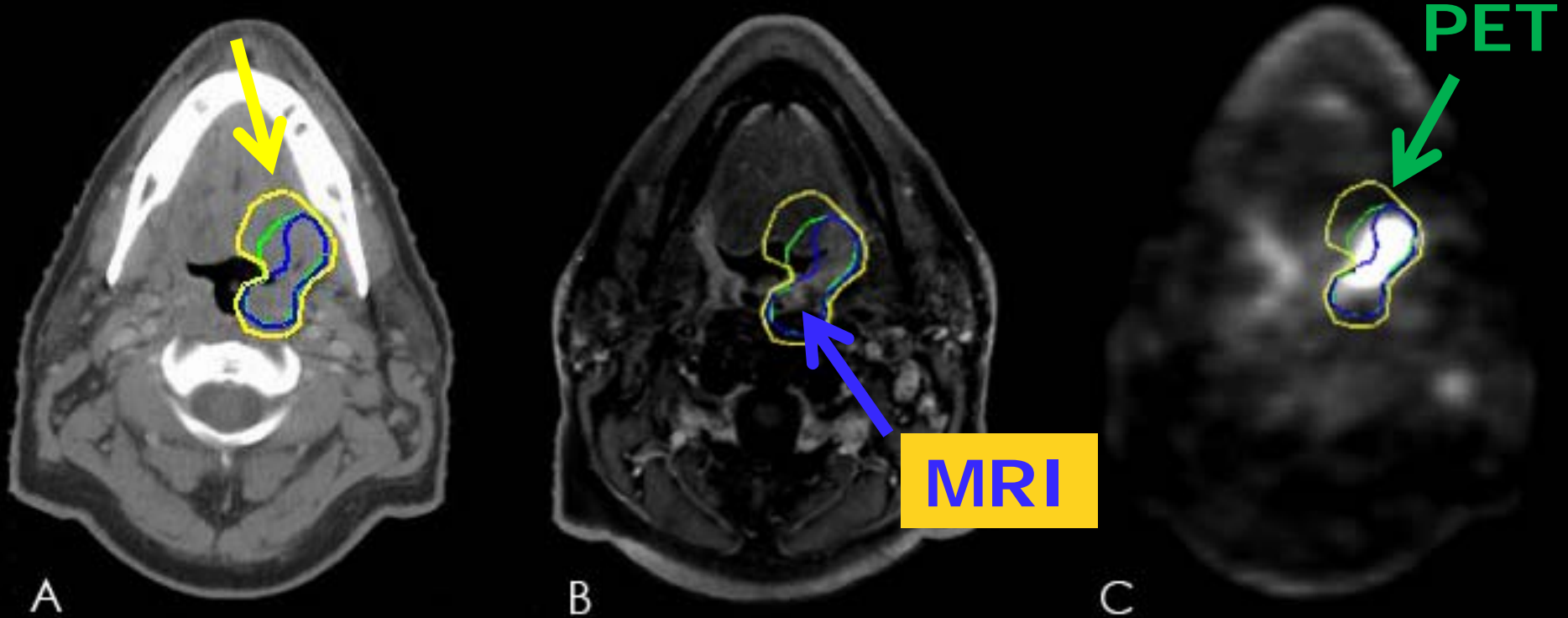
Two Issues

- **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

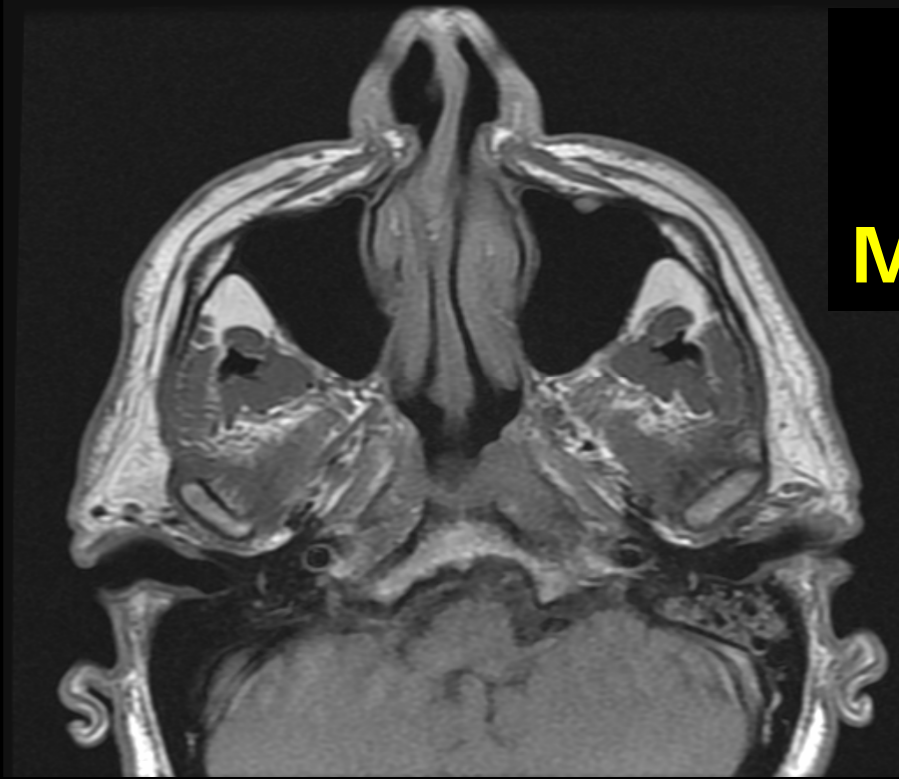


Importance of Physical Examination

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

PTV₇₀: 70 Gy over 33 Days (2.12 Gy)

High Risk Subclinical

PTV_{59.4}: 59.4 Gy over 33 Days (1.8 Gy)

Lower Risk Subclinical PTV₅₄

54 Gy over 33 Days (1.64 Gy)

GTV₇₀ to PTV₇₀

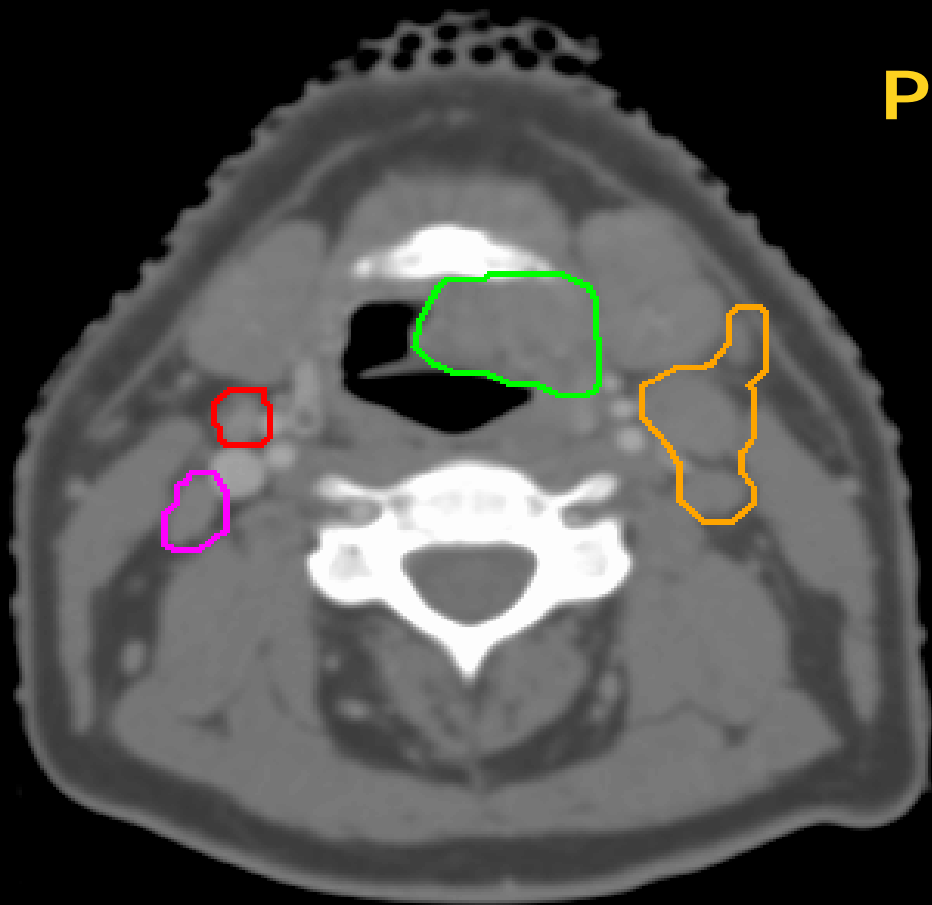
GTV: Gross tumor based on imaging, PE

GTV is also known as CTV₇₀

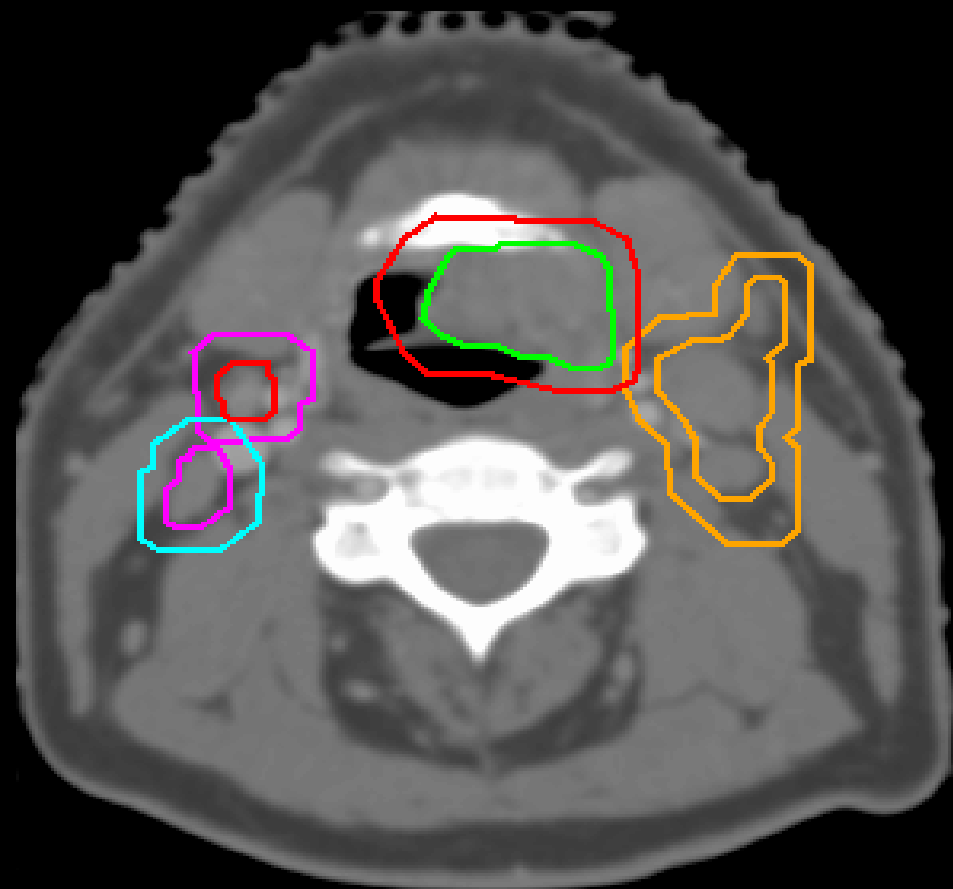
PTV₇₀: GTV + 3-5mm (based on your comfort level)

Primary and nodal GTV₇₀

PTV₇₀: GTV₇₀ + 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}

RLN

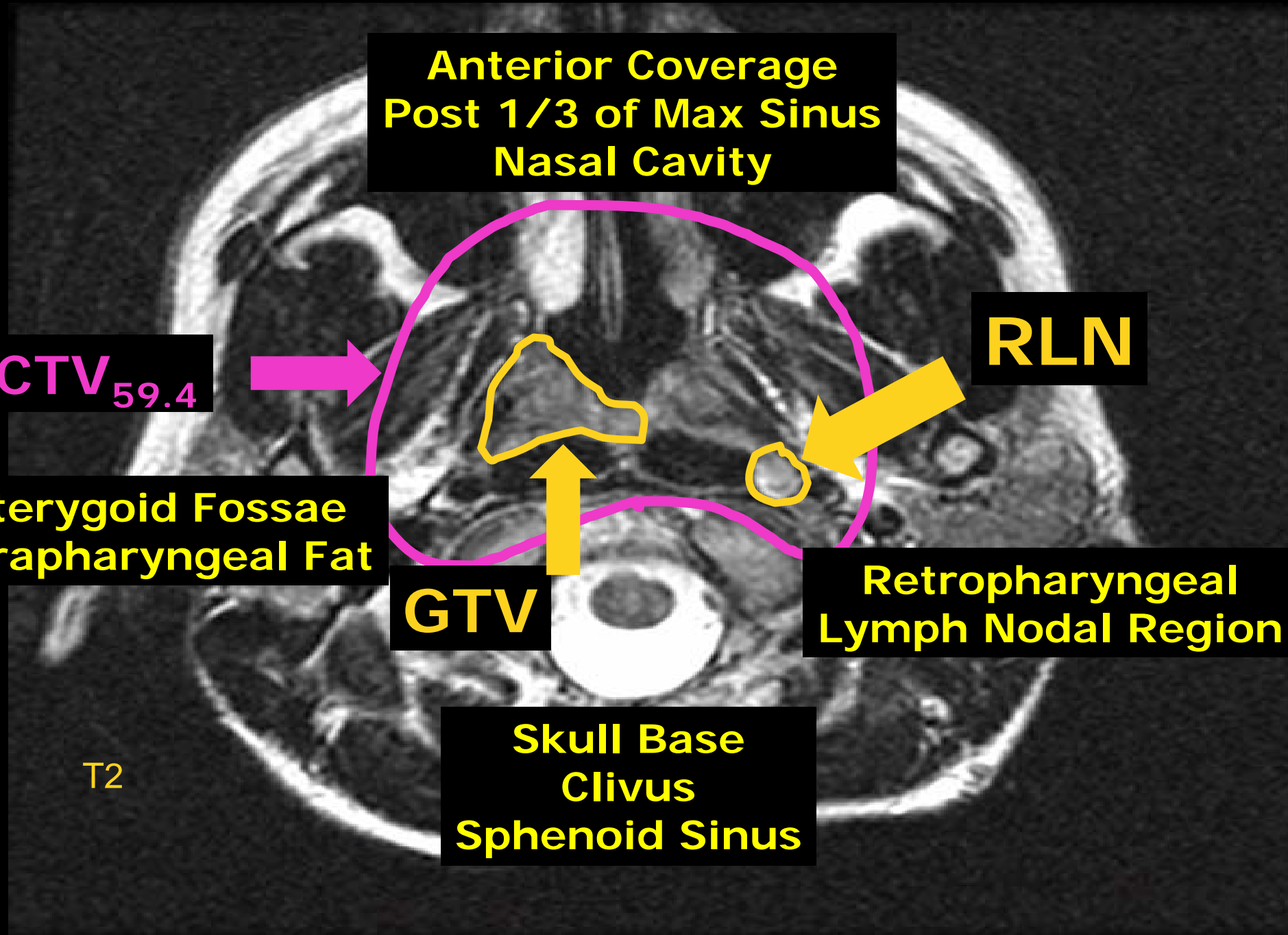
**Pterygoid Fossae
Parapharyngeal Fat**

GTV

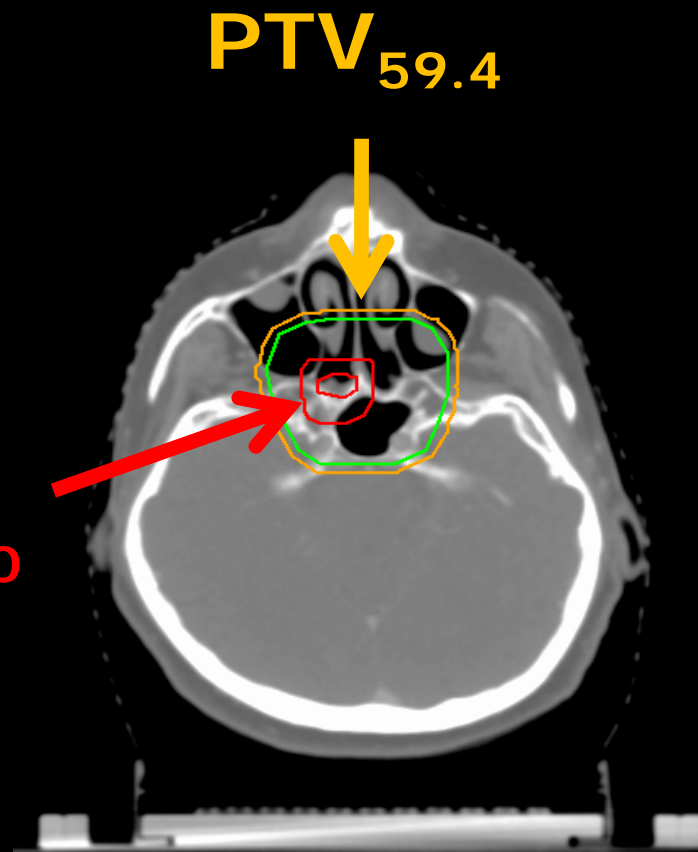
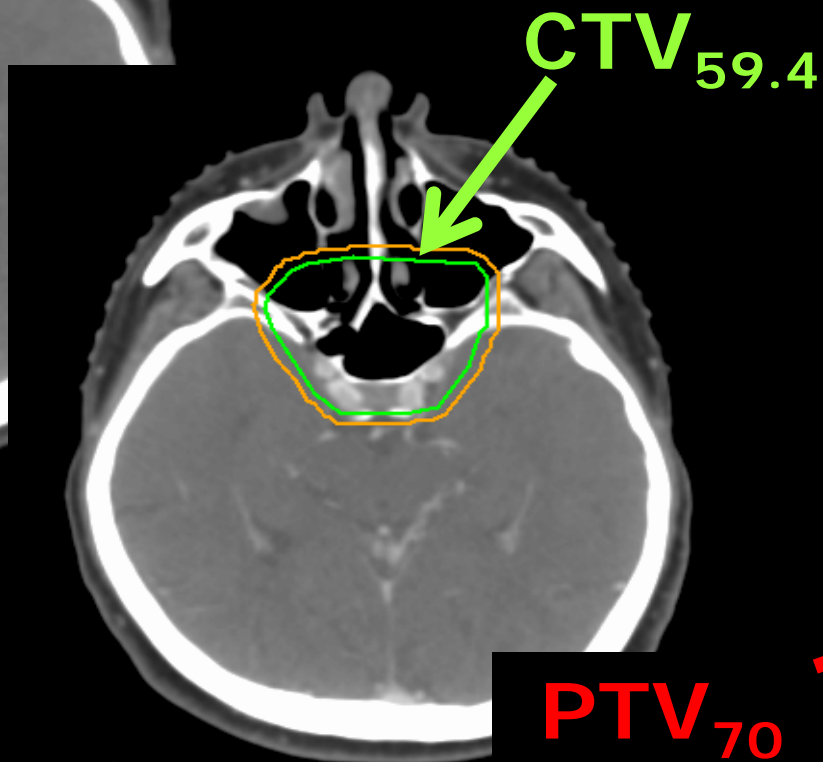
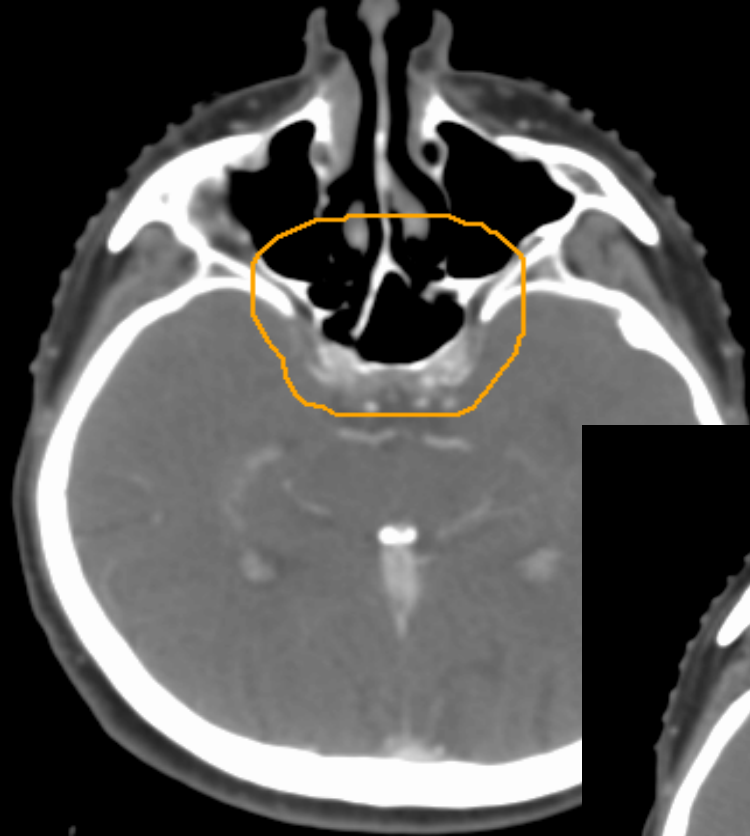
**Retropharyngeal
Lymph Nodal Region**

T2

**Skull Base
Clivus
Sphenoid Sinus**

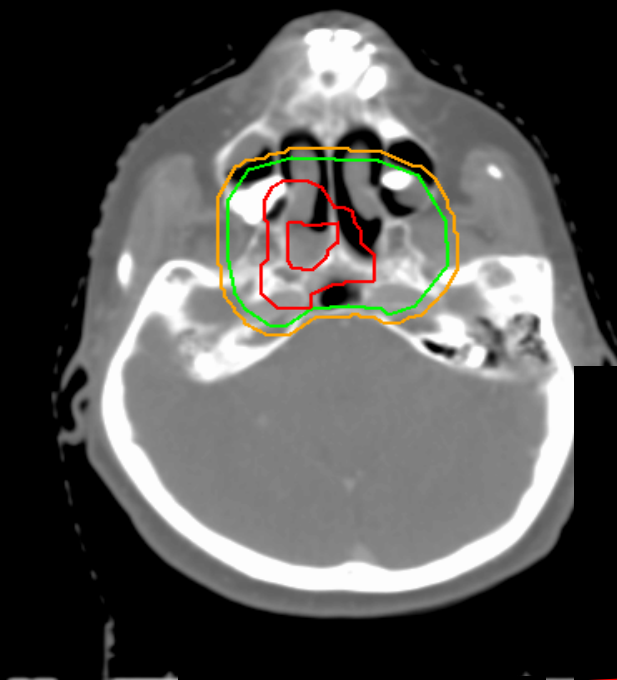


Coverage of Sphenoid Sinus, Cavernous Sinus

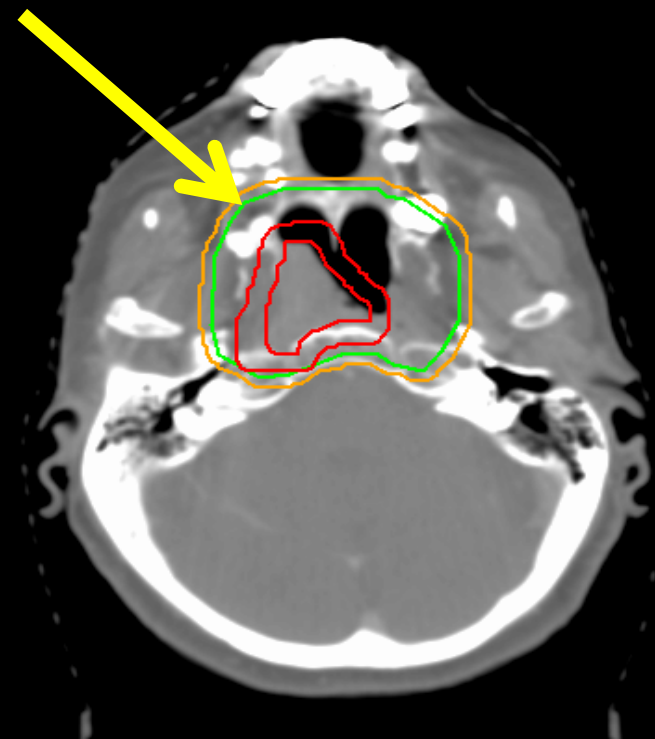
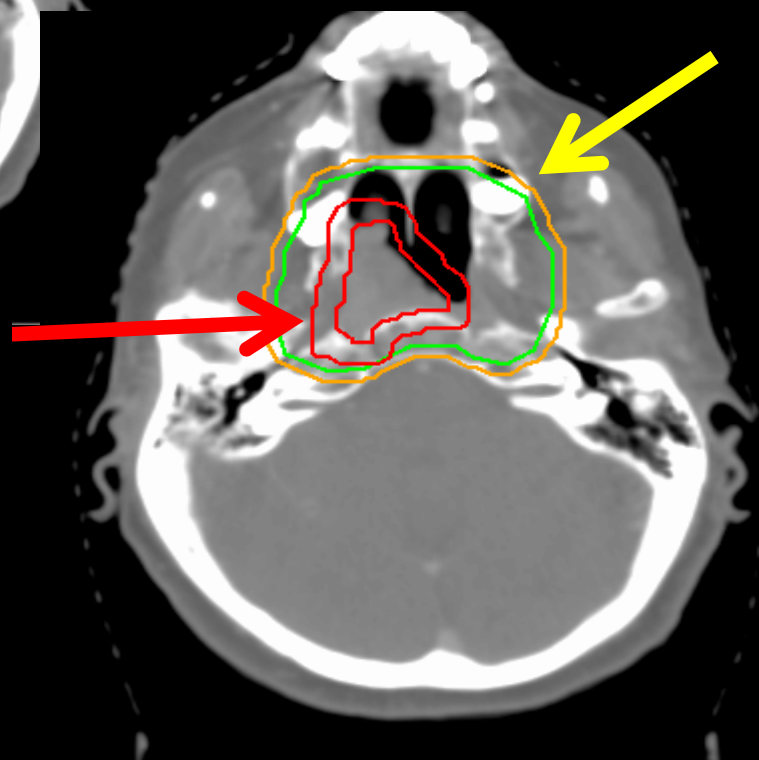


$$CTV_{59.4} + 3mm = PTV_{59.4}$$

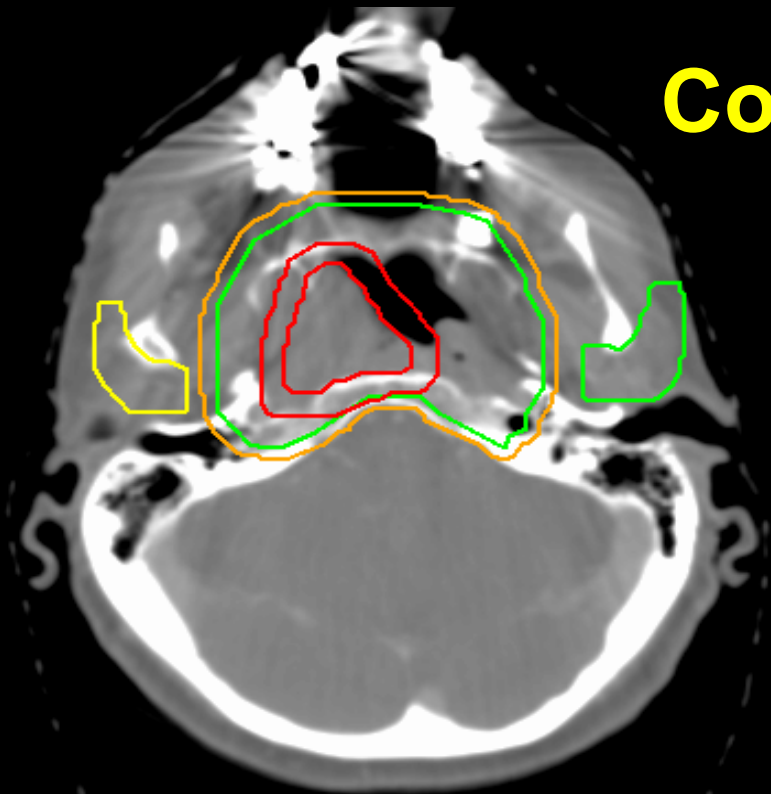
Coverage of Skull base Pterygopalatine Fossae



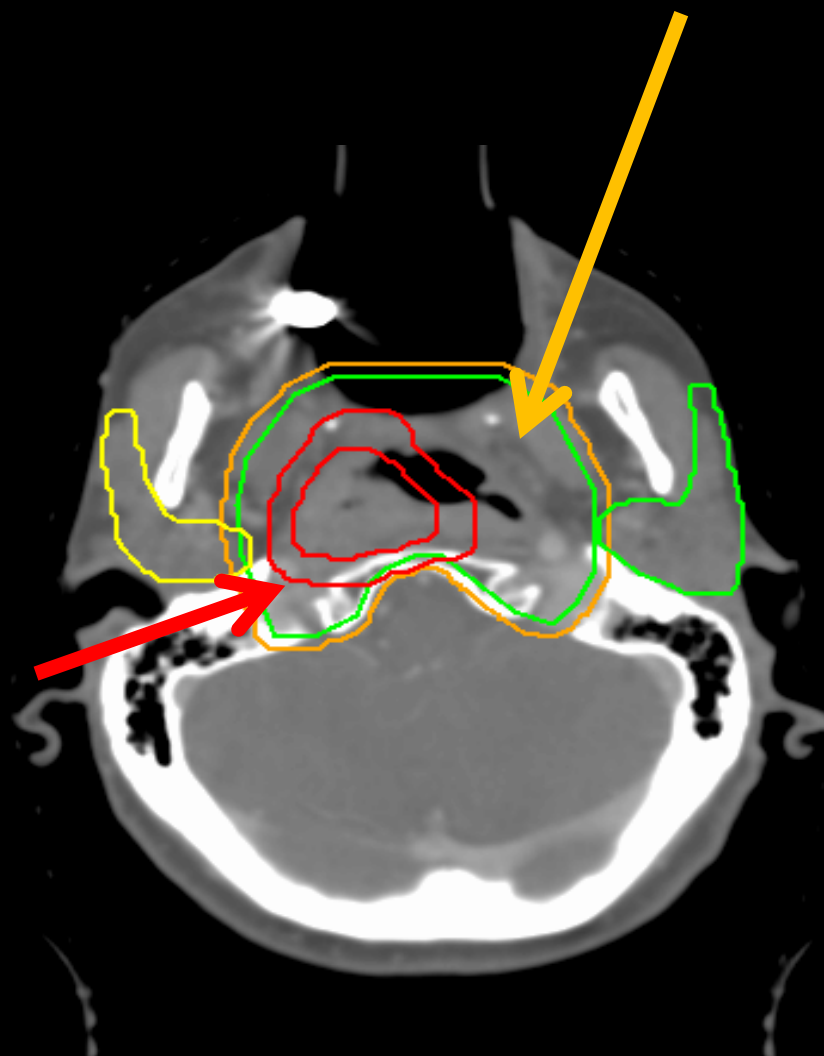
PTV₇₀



Coverage of Parapharyngeal Fat



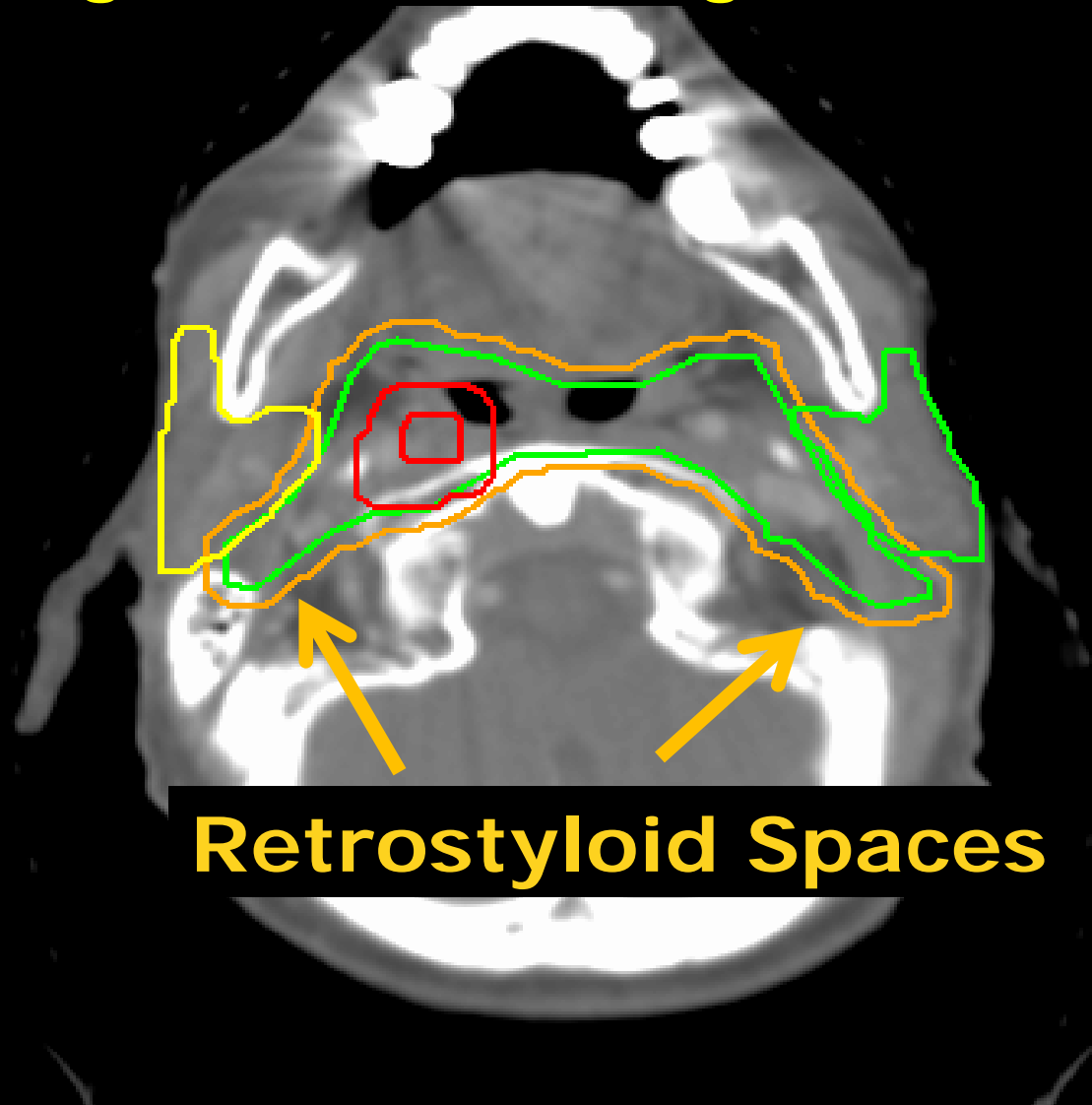
PTV₇₀



Nasopharynx(Nodal): CTV_{59.4} Delineation

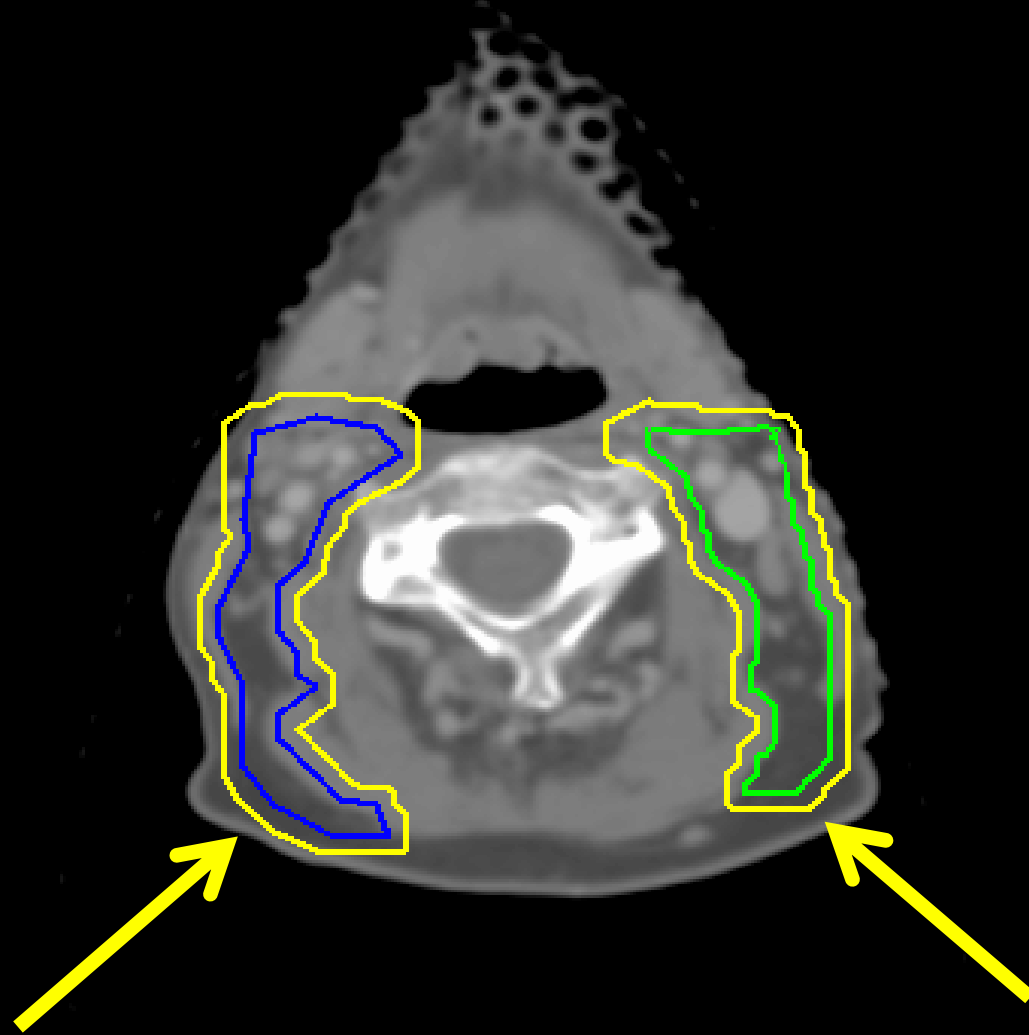
- **Retrostyloid space**
- **Bilateral levels Ib through V**
- **Level Ib can be omitted in node negative disease**

Coverage of Retrostyloid Space Regardless of N stage for NPC

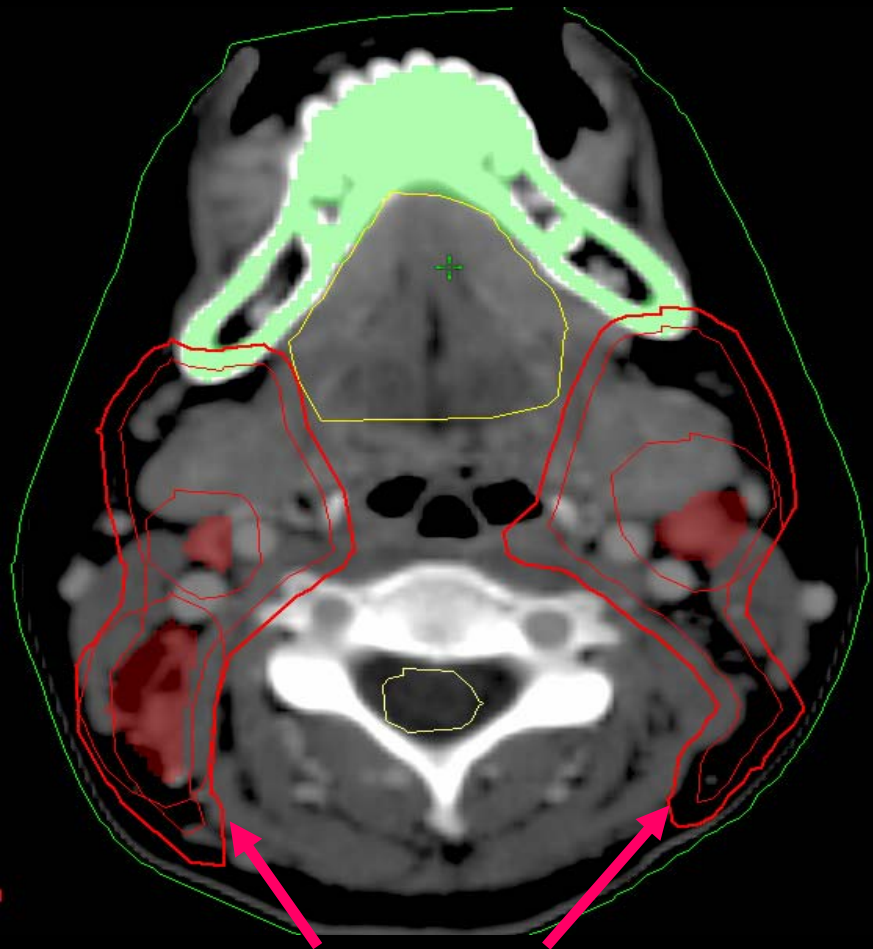


Retrostyloid Spaces

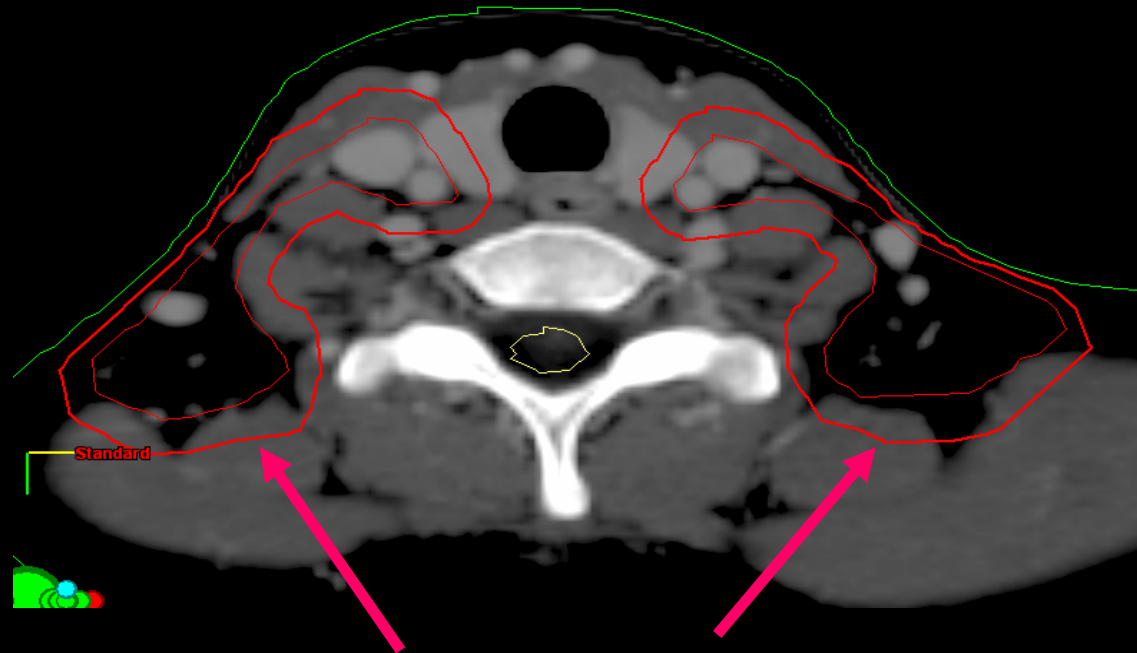
Coverage of level V



Level V Nodal Coverage

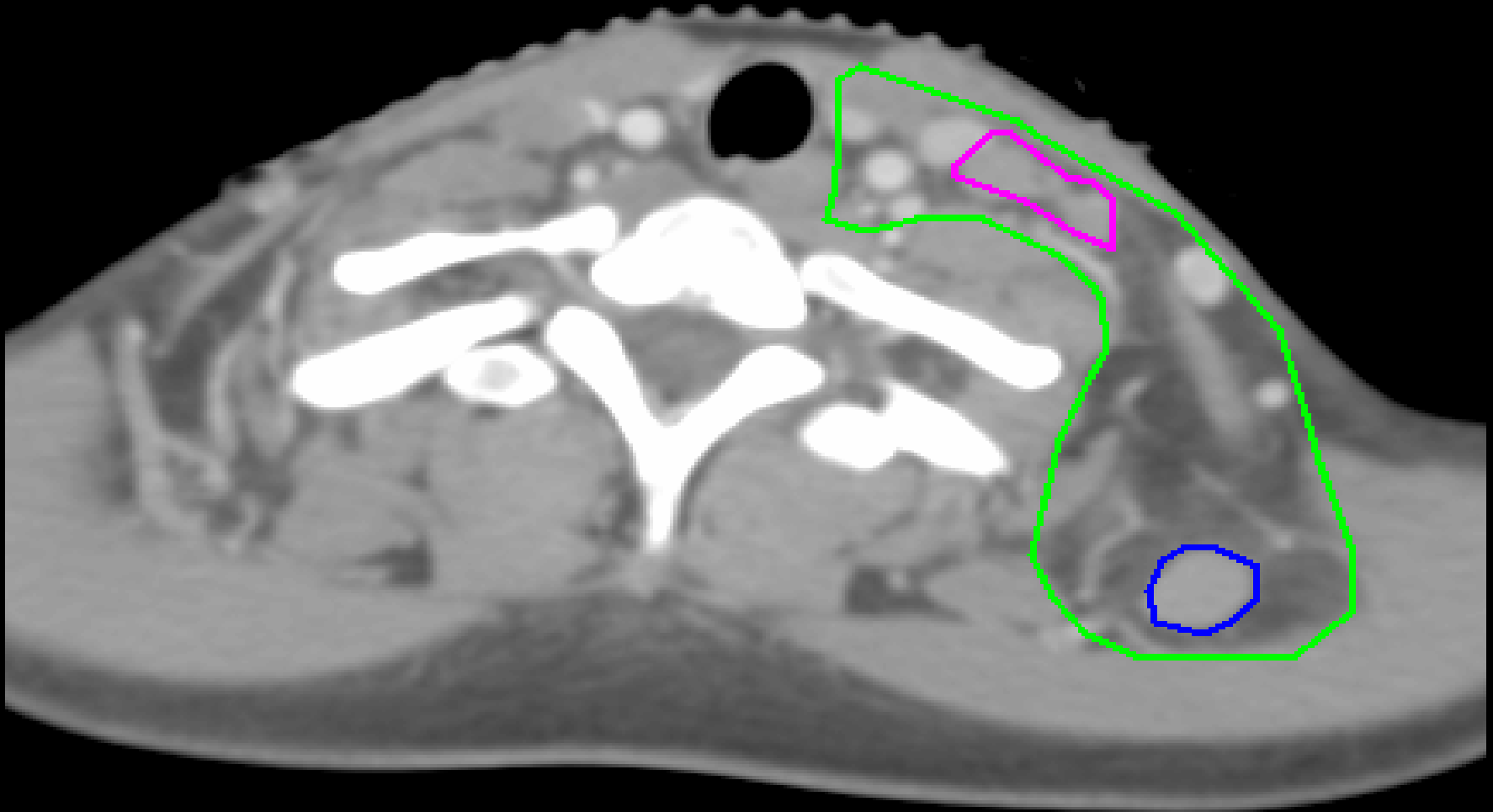


High Risk PTV



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**

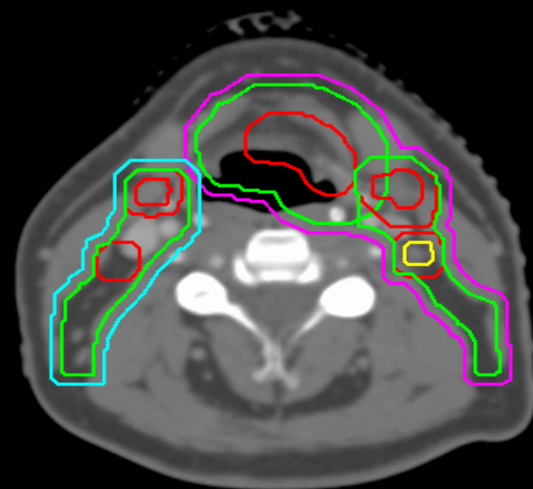
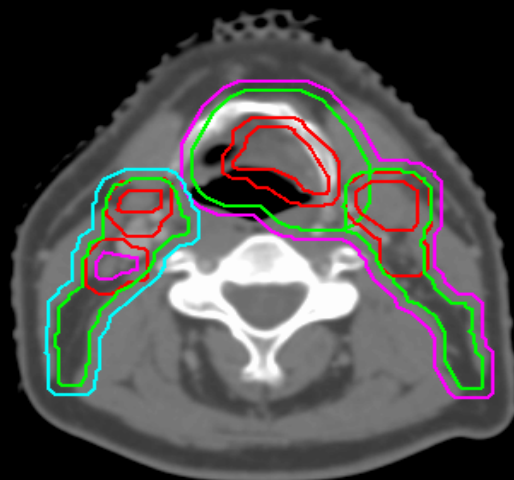
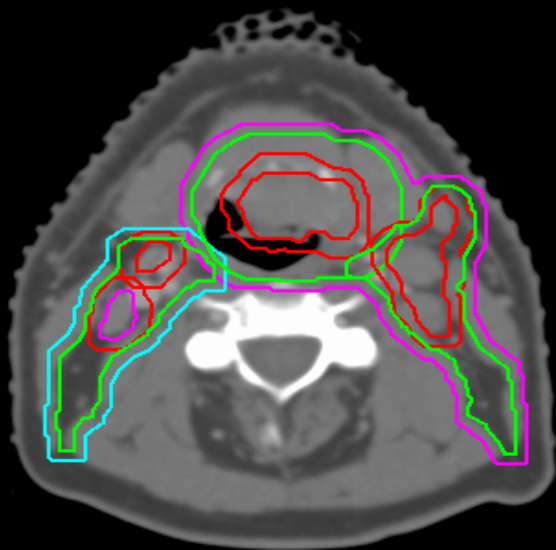


Oropharynx (Primary)

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



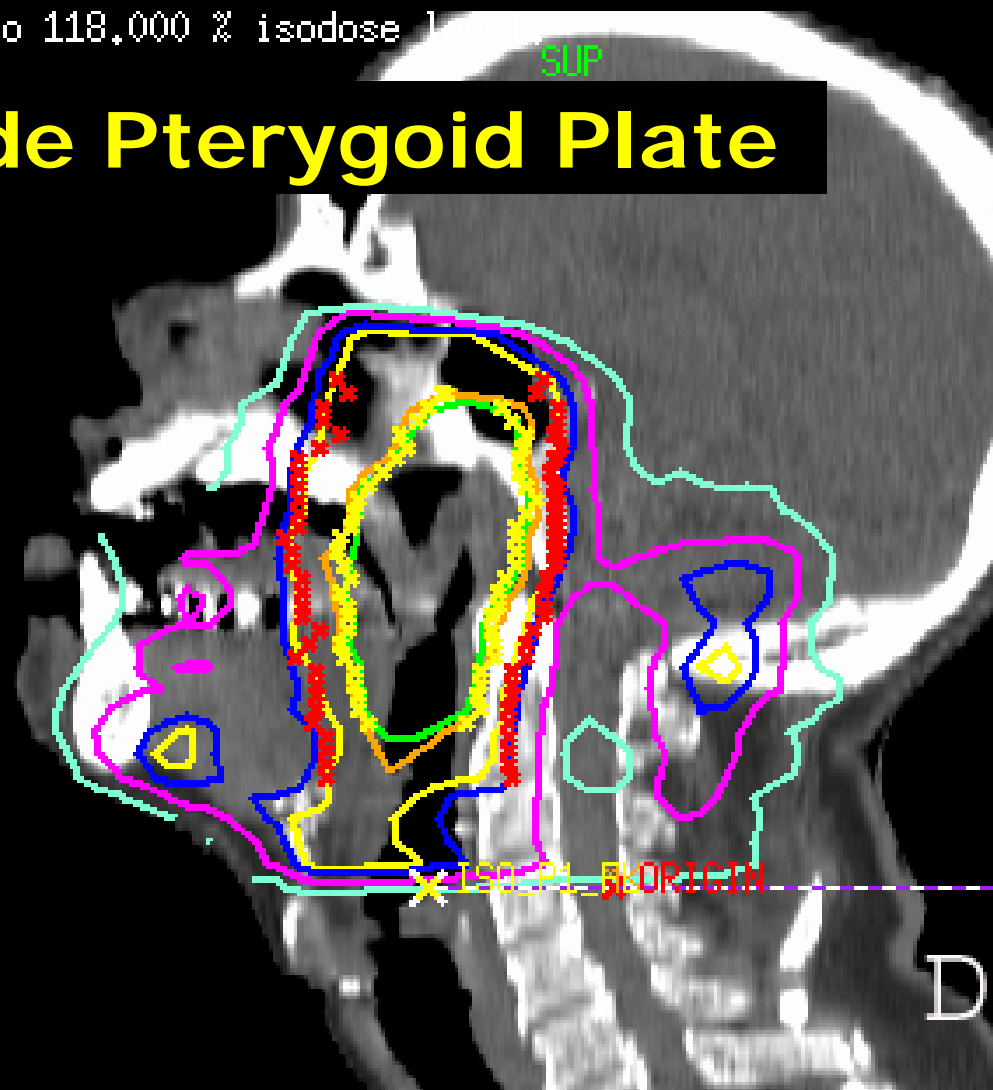
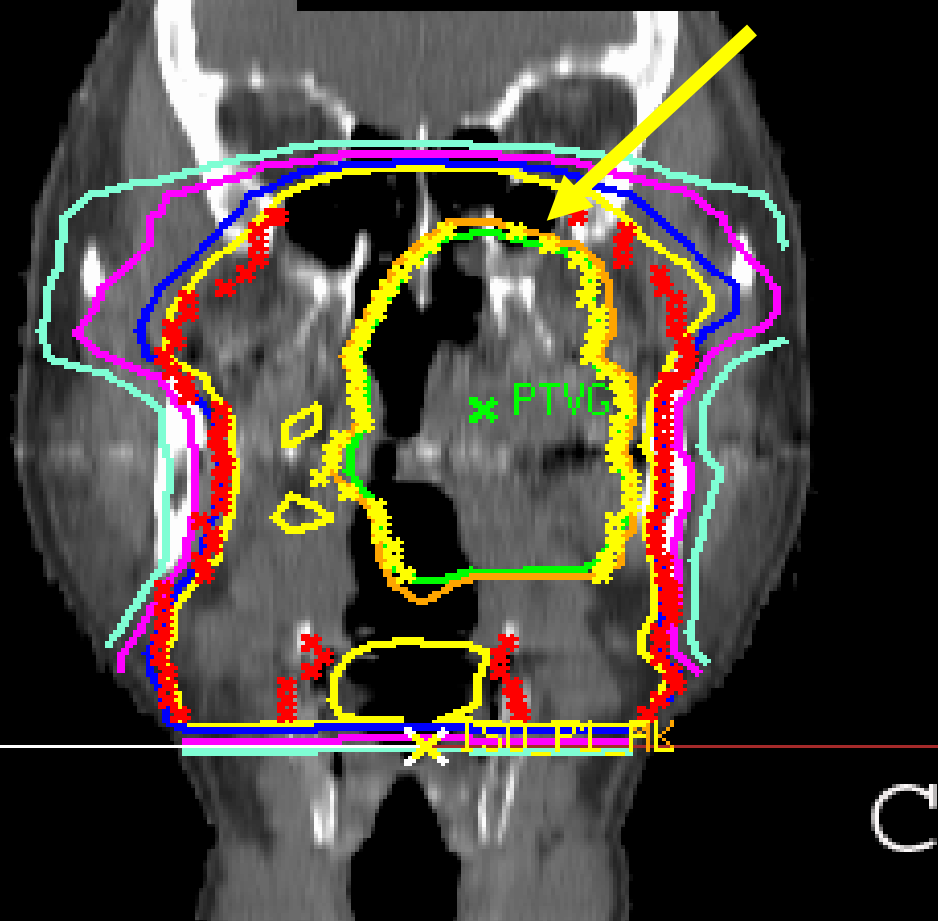
0 % isodose level

to 118,000 % isodose level

SUP

SUP

Need to Include Pterygoid Plate

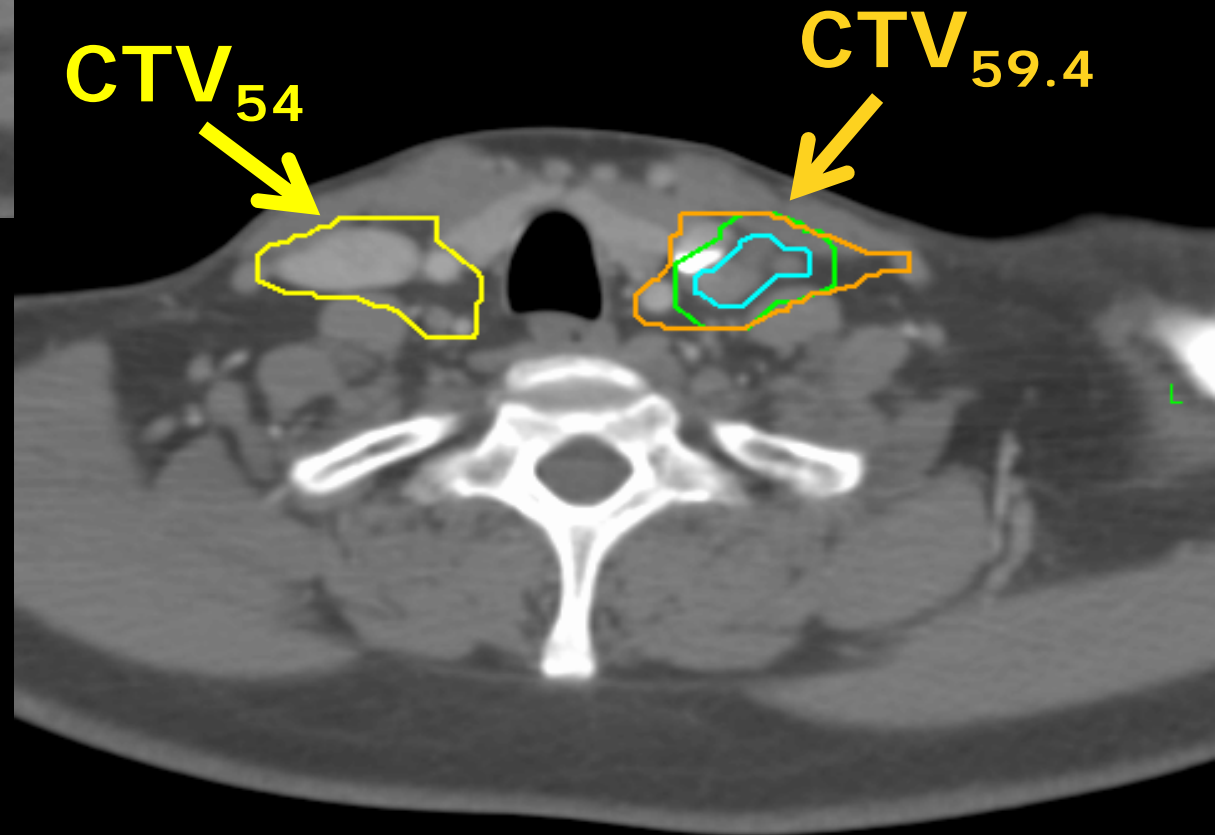
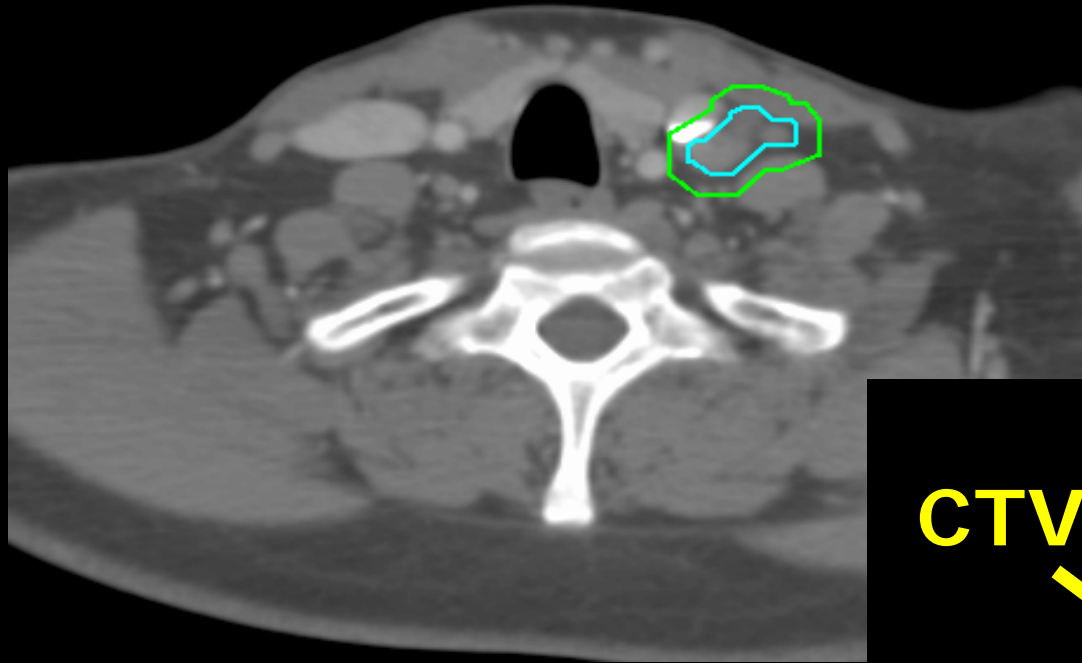


Look at the growth pattern of your cases to determine CTV_{59.4} coverage

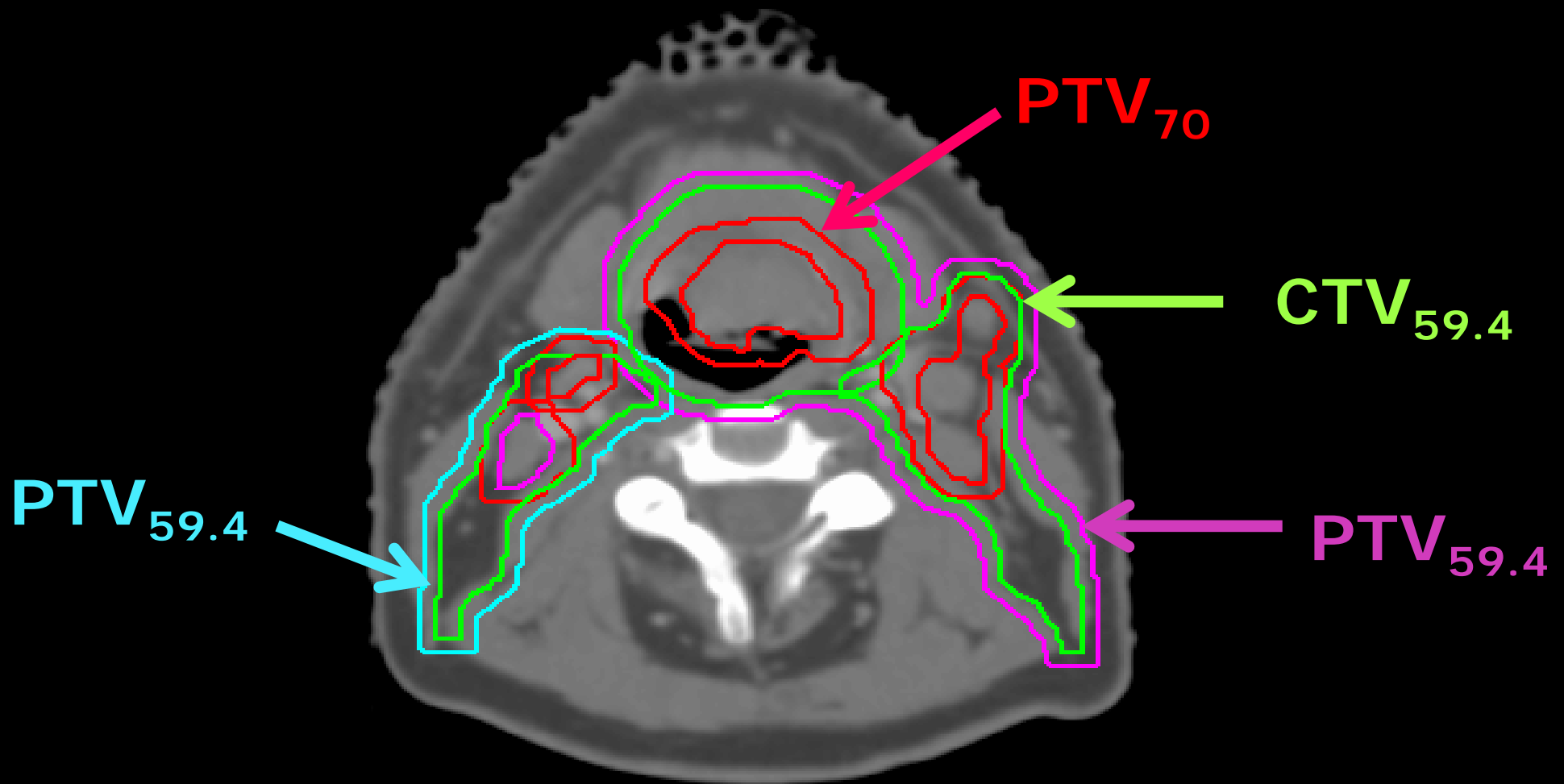
Oropharynx (Nodal): CTV_{59.4} Delineation

- **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**

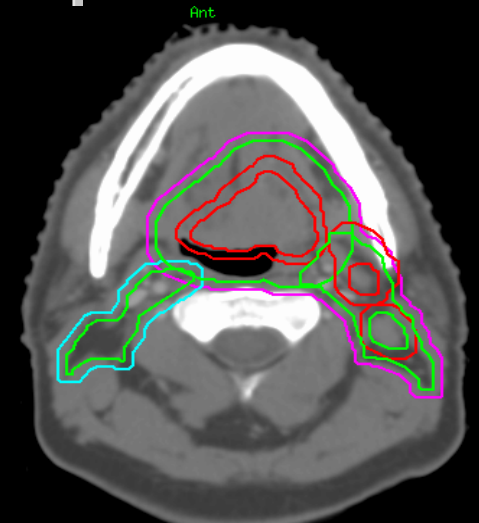
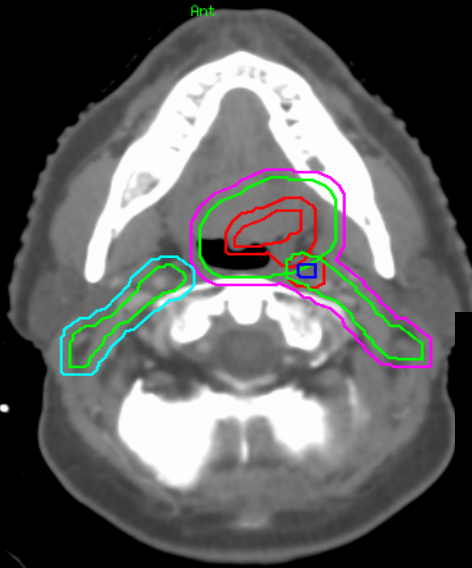
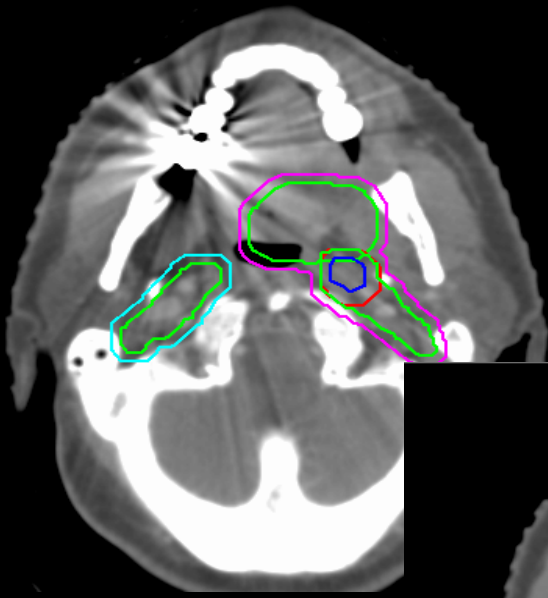


Base of Tongue CA



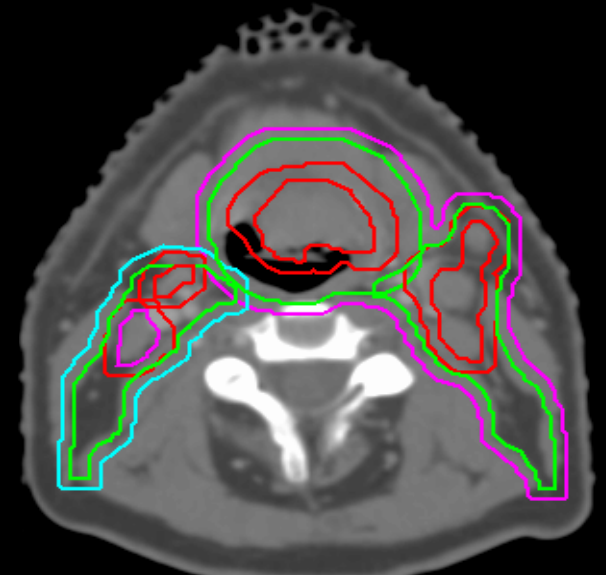
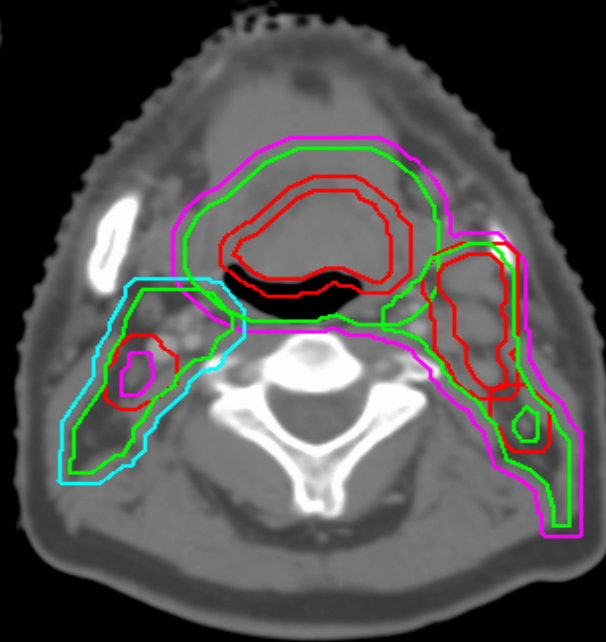
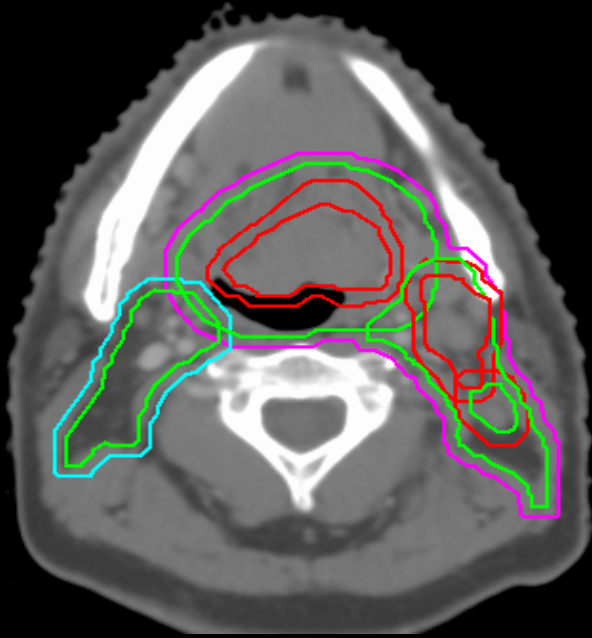
Example Stage IVB oropharynx CA

Superior to Inferior slices



**Treat Bilateral
Retrostyloid Spaces**

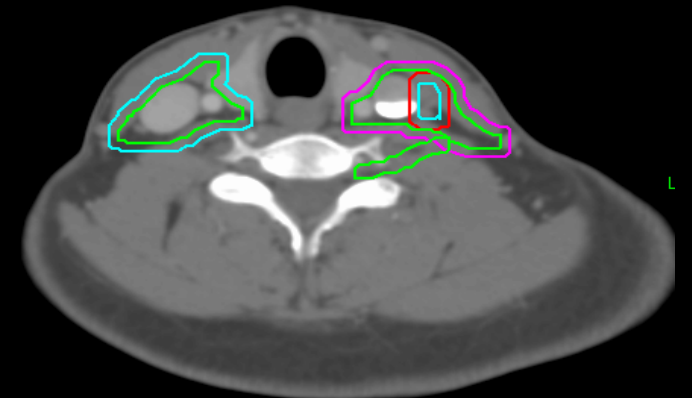
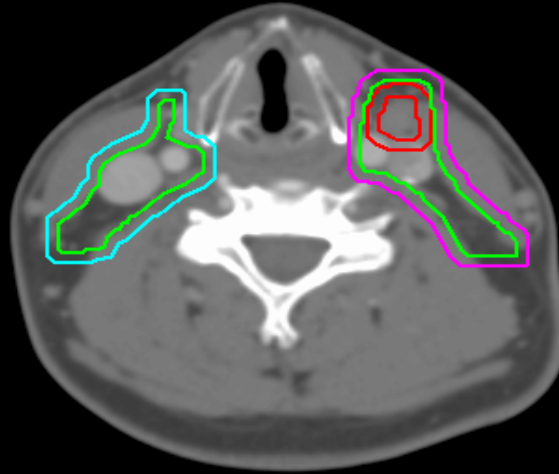
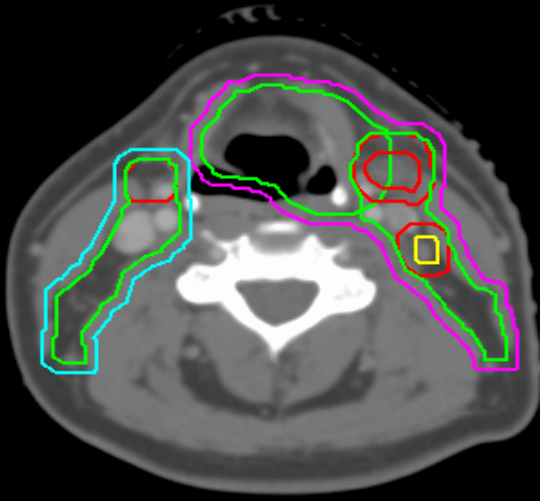
**No actively trying to spare
Constrictor muscles**



**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-: CTV₅₄ 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)
- $CTV_{54} + 3mm = PTV_{54}$

**Omit high
levels IIA/IIB**

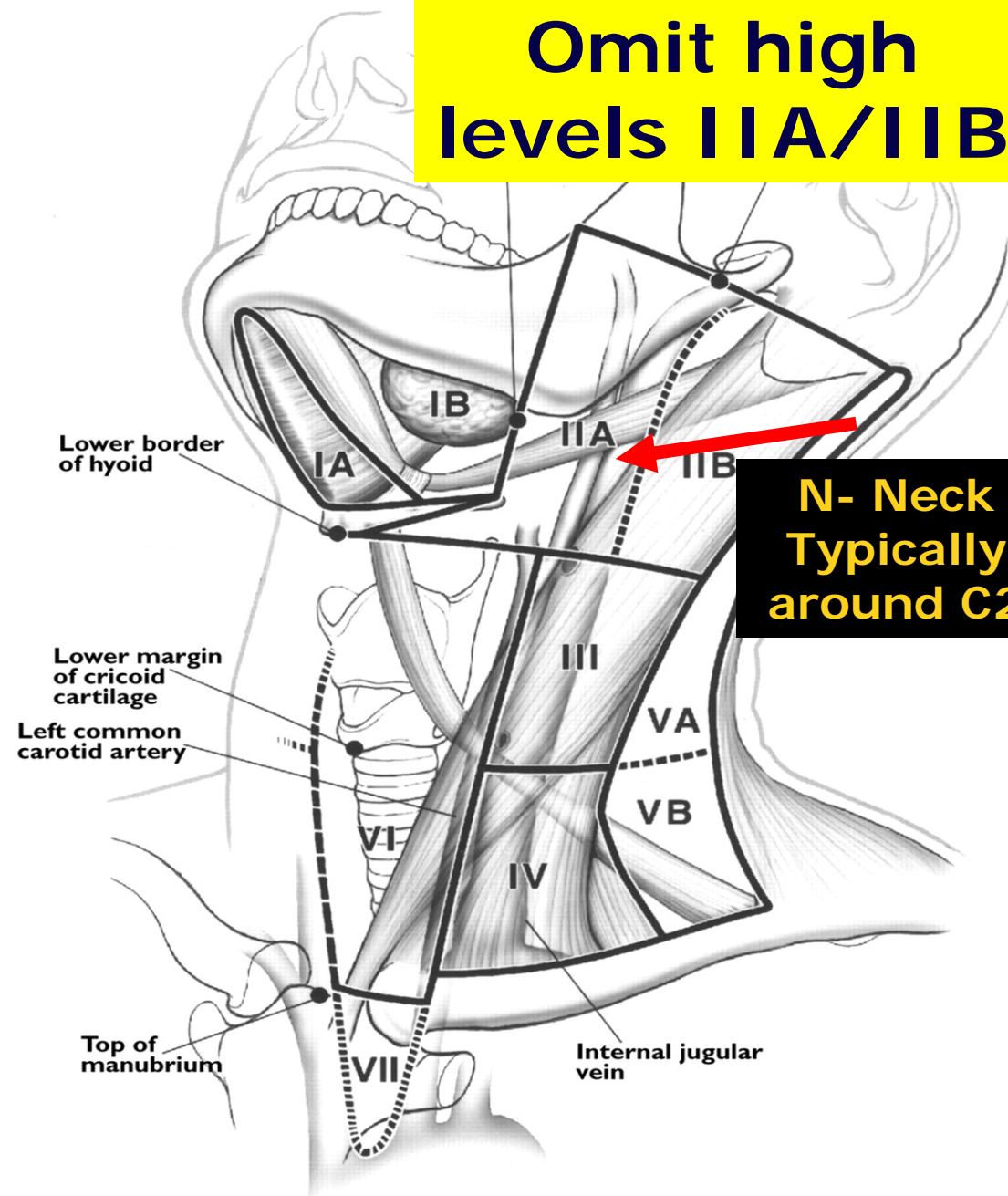
Lower border
of hyoid

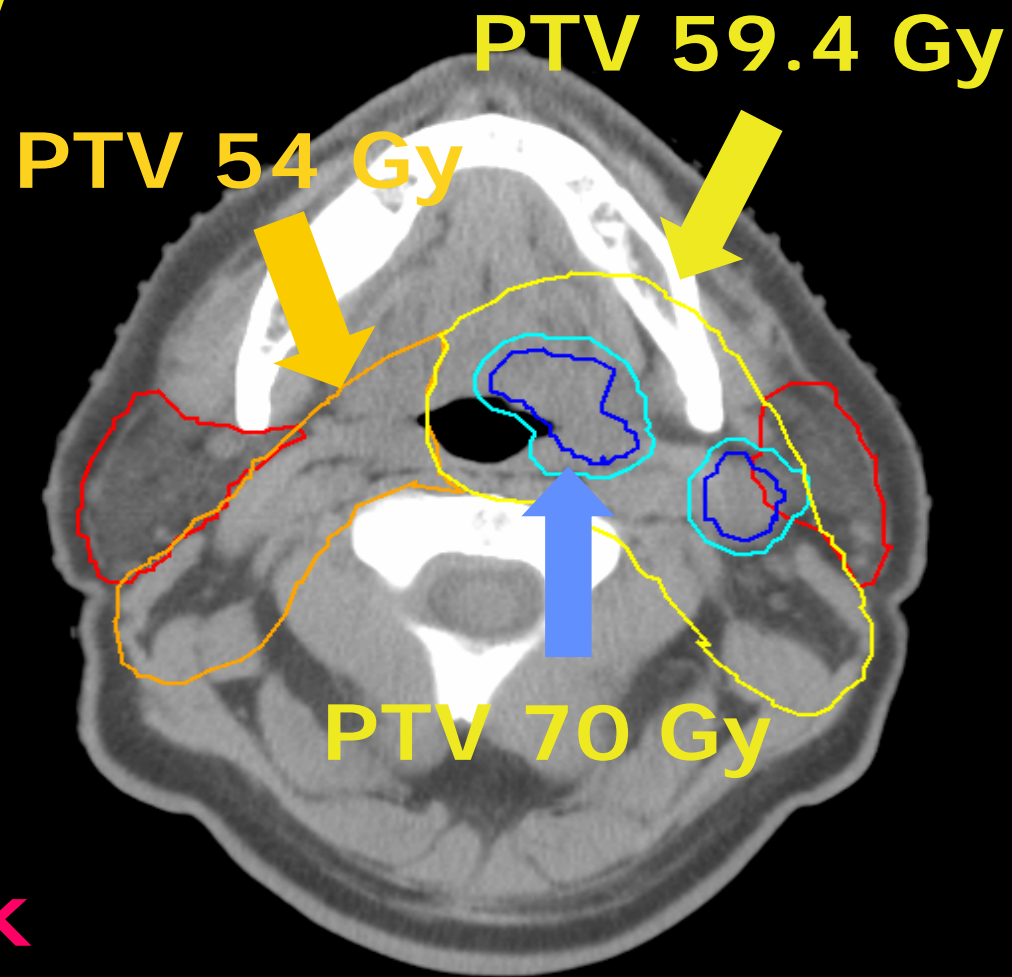
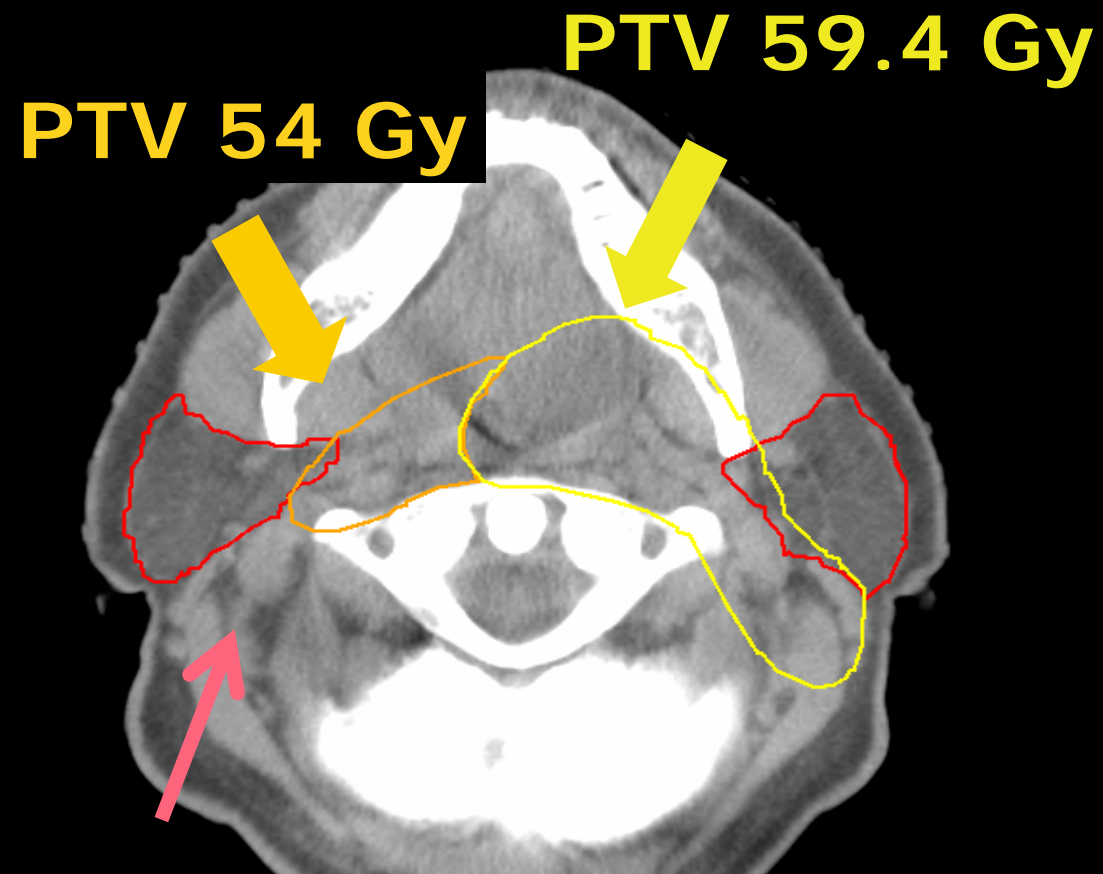
Lower margin
of cricoid
cartilage
Left common
carotid artery

Top of
manubrium

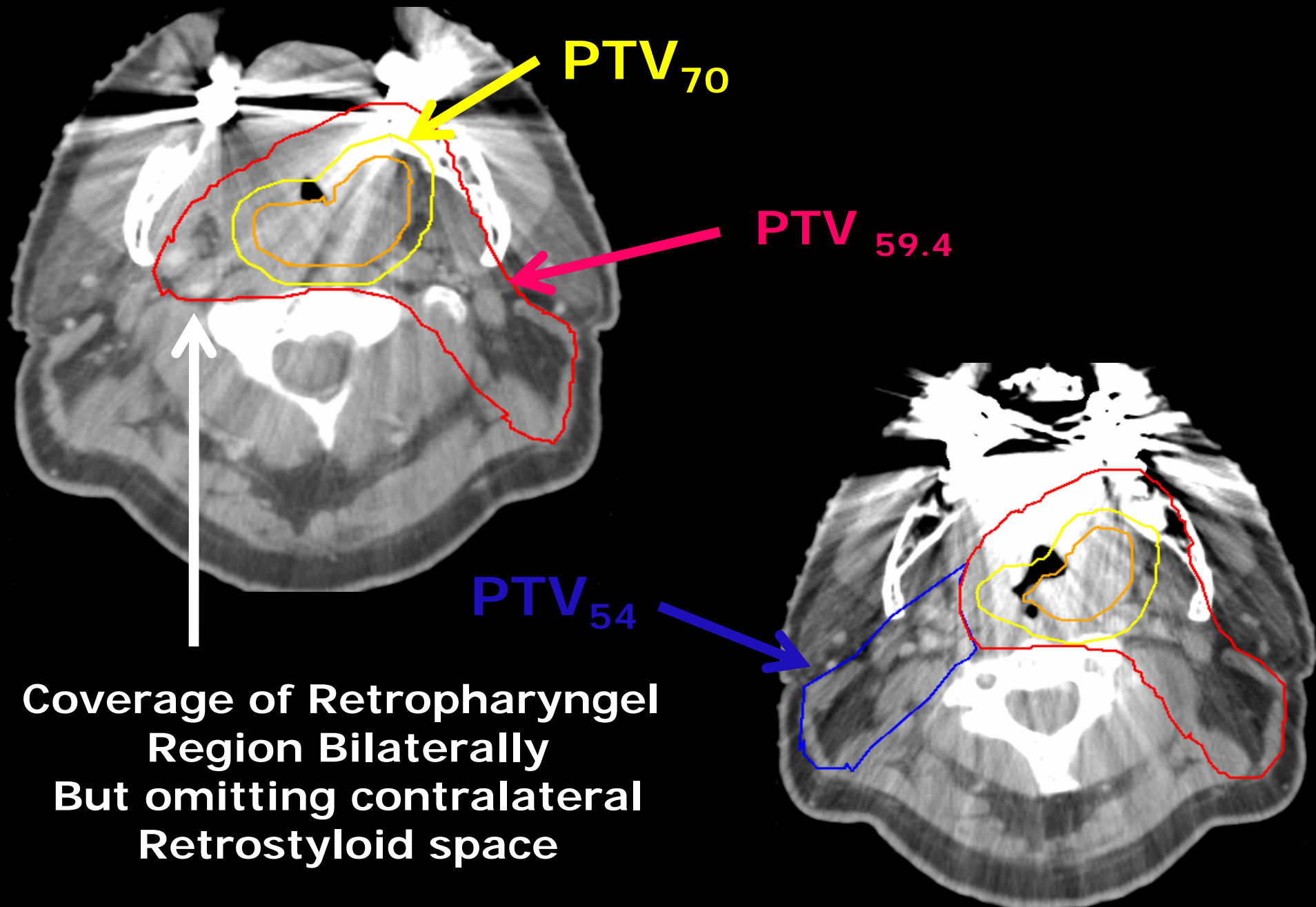
Internal jugular
vein

**N- Neck
Typically
around C2**

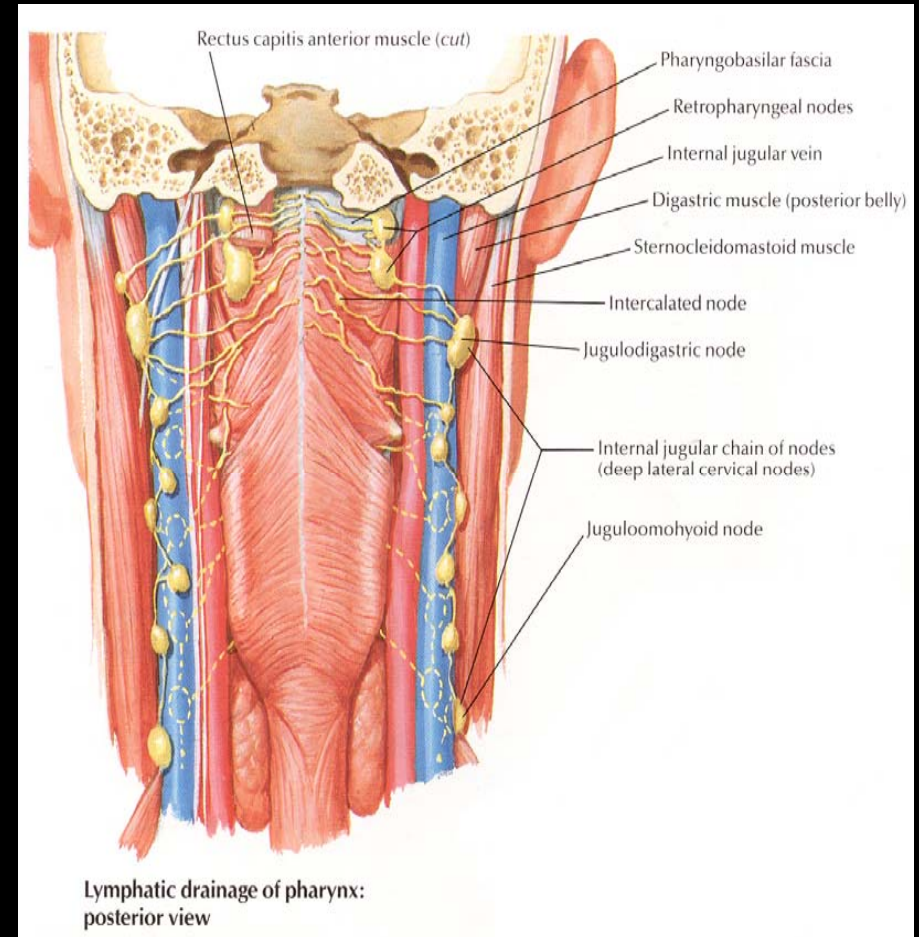
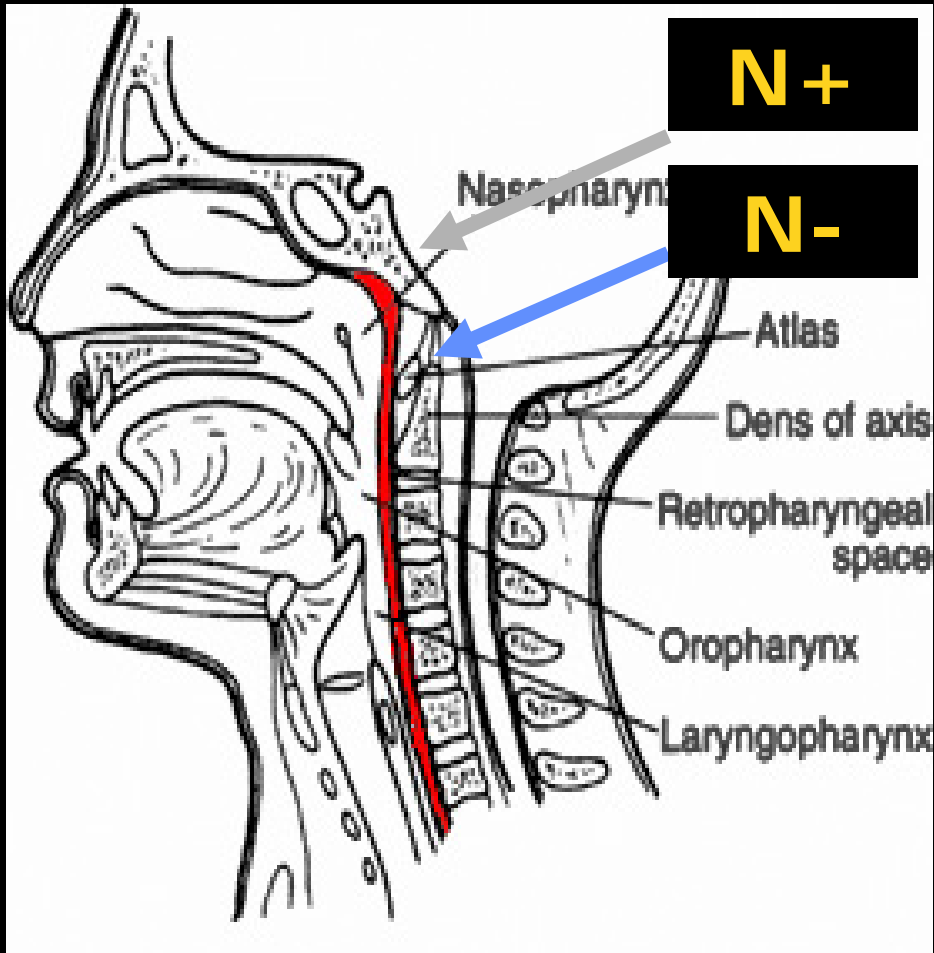




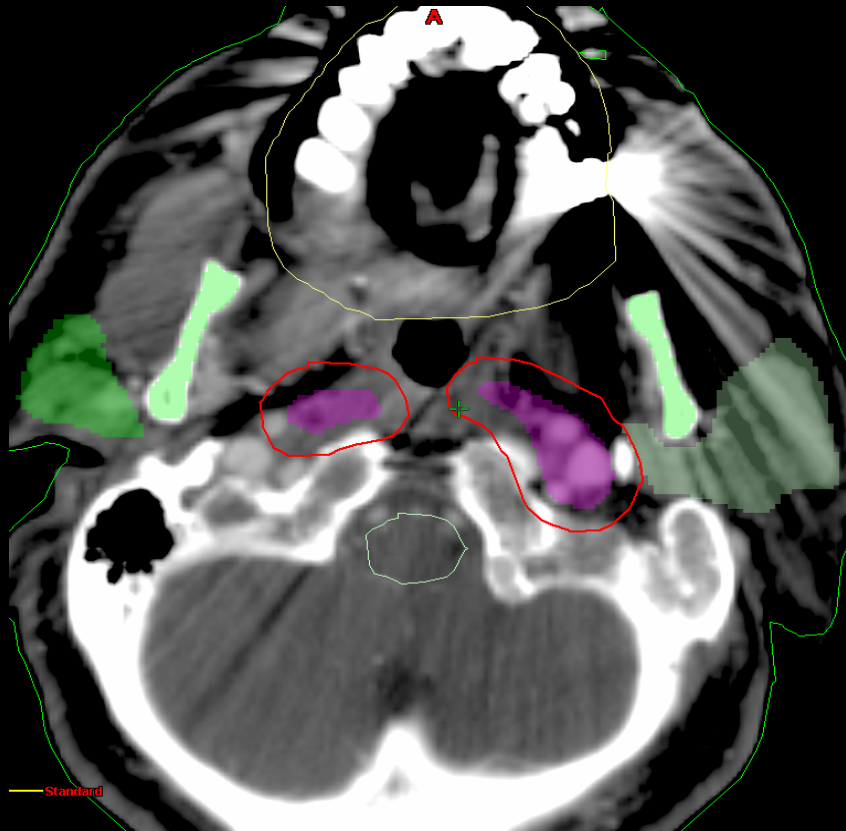
**N- Contralateral Neck
Can Spare the
high IIA/IIB nodes**



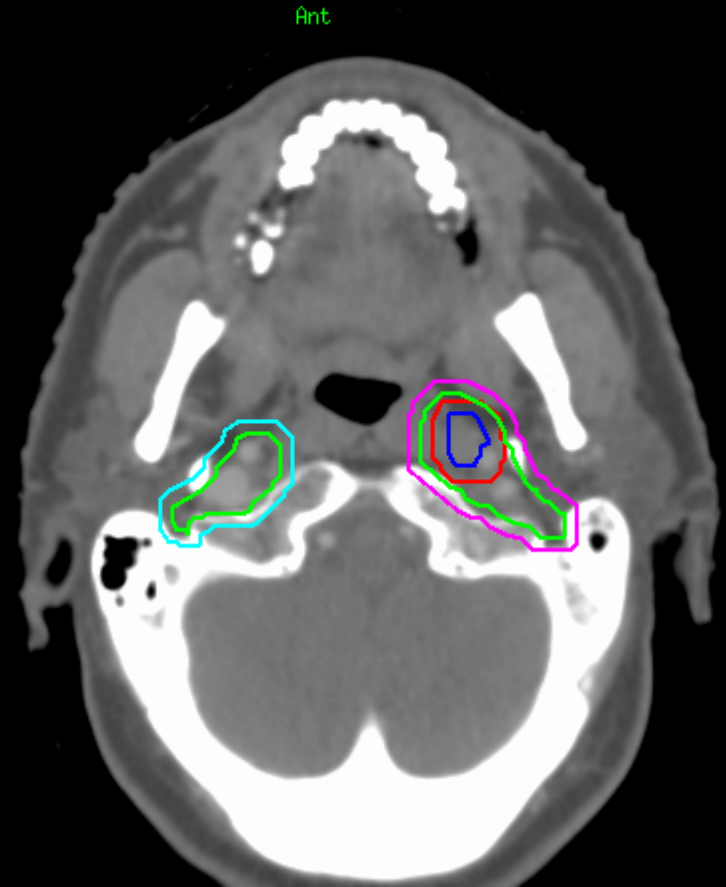
Retropharyngeal Space



Contour at RP nodal level for bilateral N+ neck



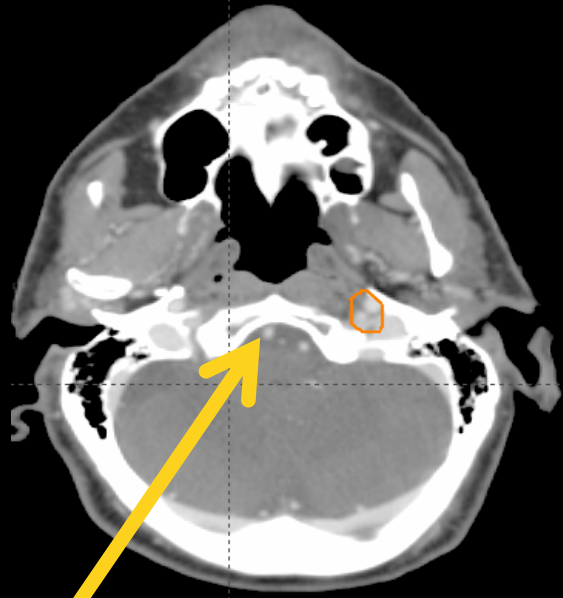
Univ Michigan



MSKCC

Superior Aspect of Nodal CTV for Contralateral N0 Neck

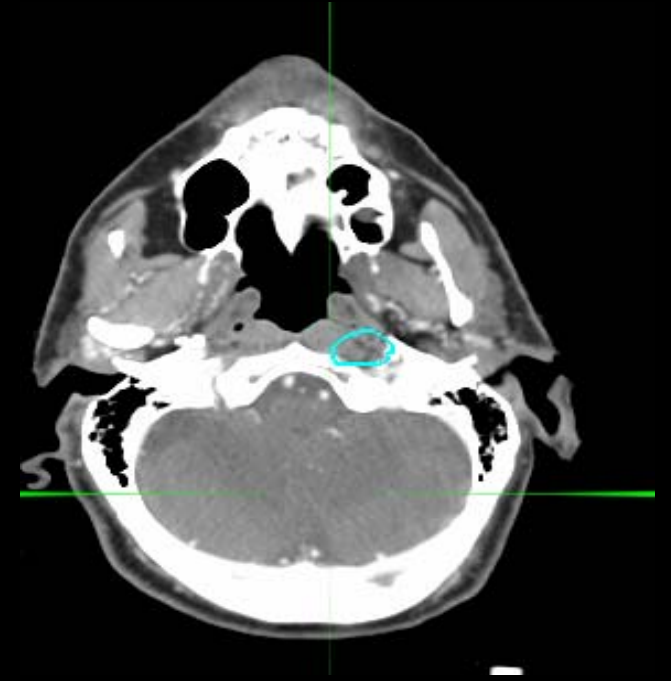
MSKCC



U Michigan



MDACC



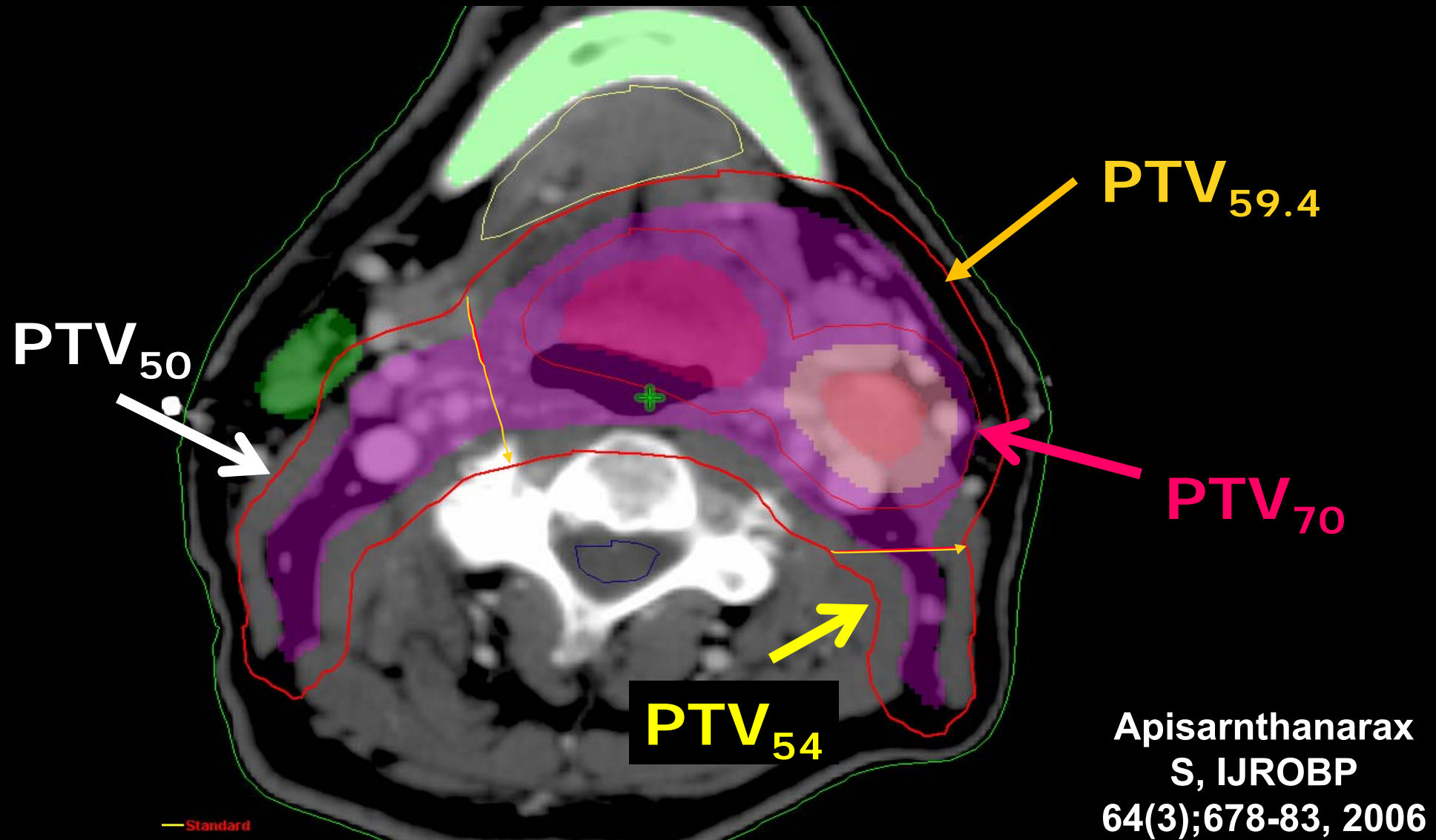
C1

Courtesy of Q Le, ASTRO Practicum 2008

Can We further Dose Paint?

Even a lower risk microscopic region!

Perhaps we should have CTV₅₀



PTV₅₀

BED calculation is 57.6 for tumoricidal 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

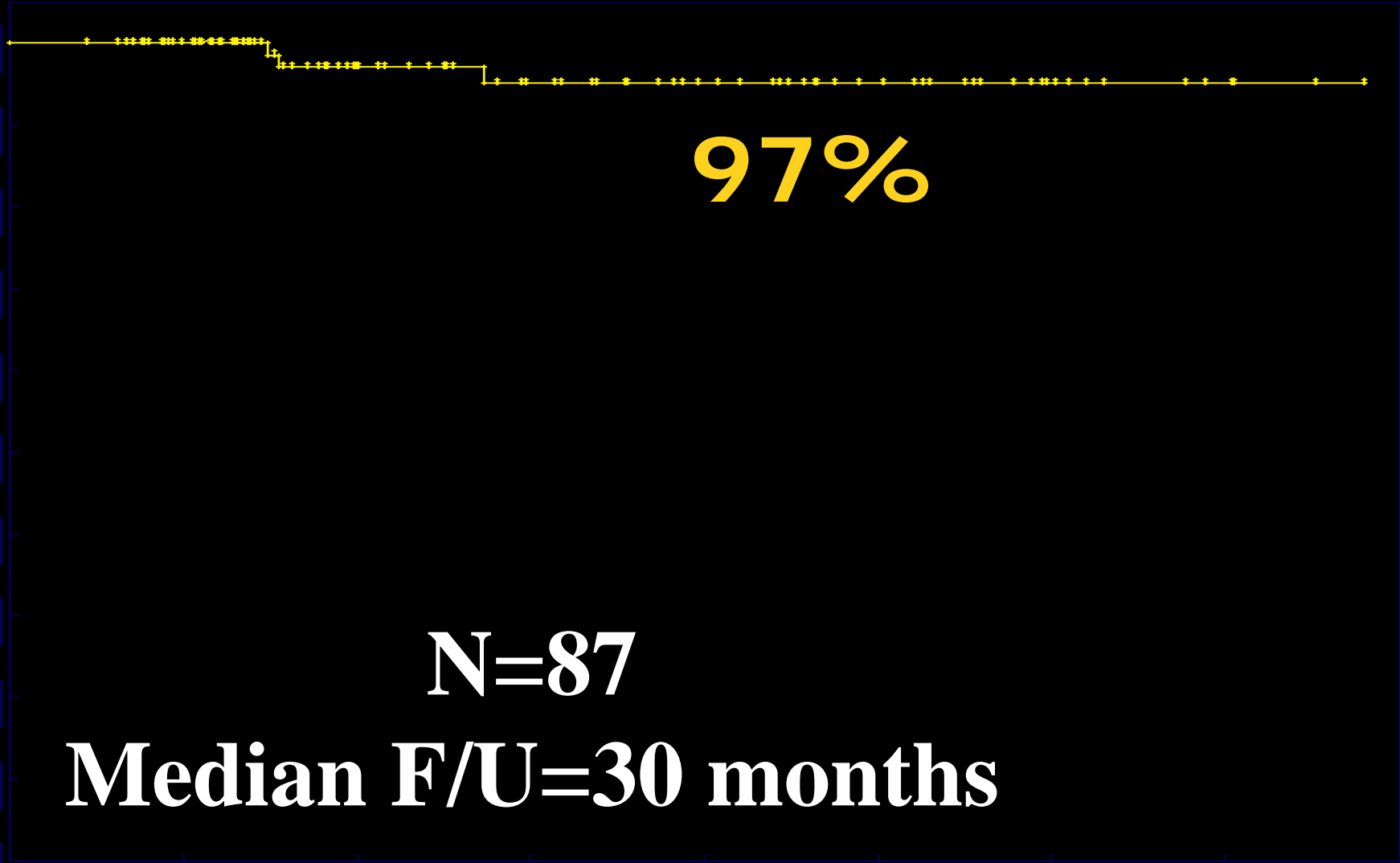
% Local PF Rate

97%

N=87

Median F/U=30 months

Months



RTOG PROTOCOL 0225

IMRT for NPC (Lee N., JCO 2009)

Stage: I-IVb

Histology:

WHO I-III

**R
E
G
I
S
T
E
R**

70 Gy to gross disease
concurrently

59.4 Gy to microscopic
disease

Over 33 days

CT: (\geq T2b and/or + LN

Local Progression-Free Interval

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

Regional Progression-Free Interval

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

IMRT for Oropharynx: Patients Population

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

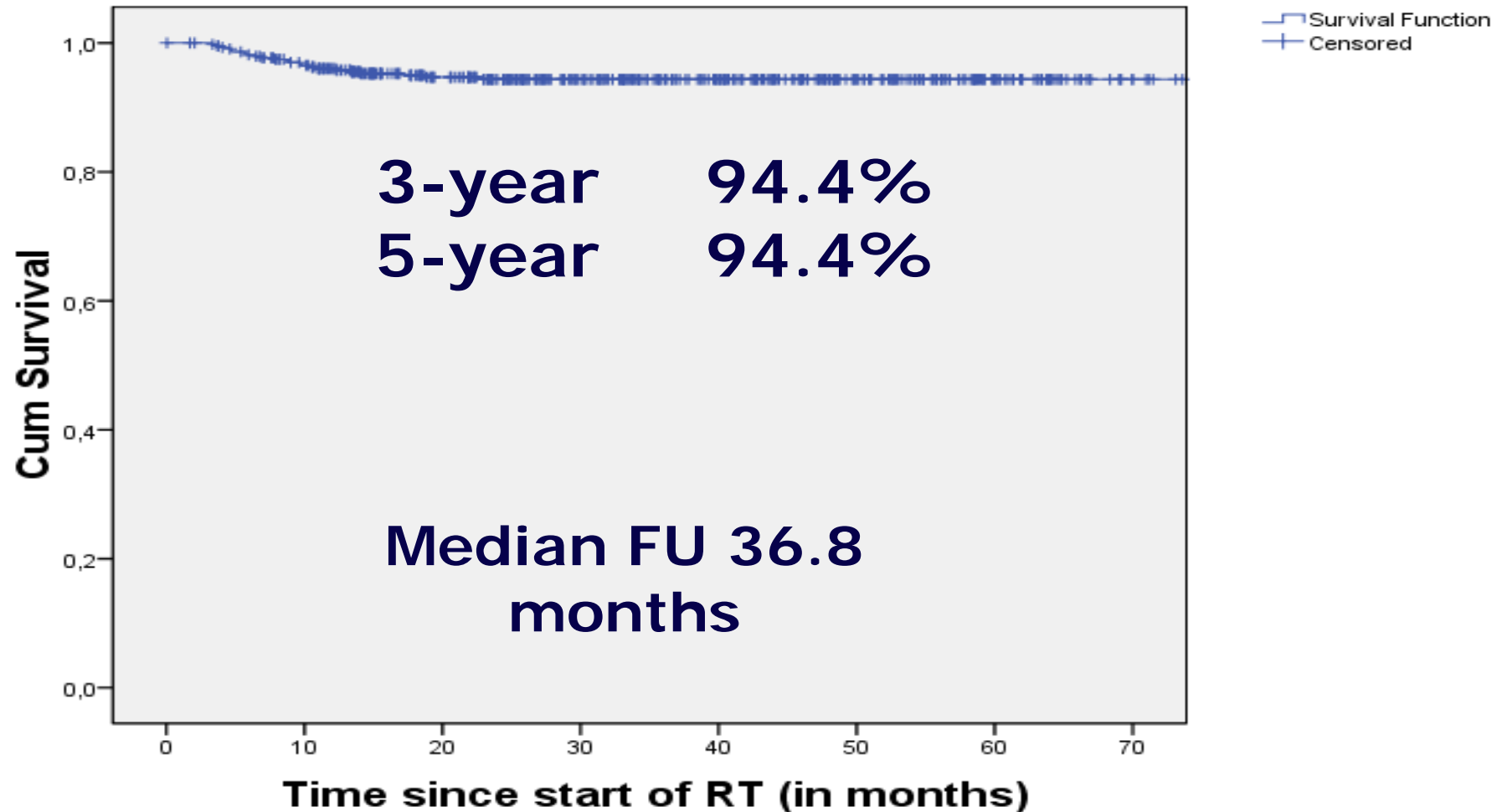
Site :	Tonsil	50%
	Base of Tongue	46%
	Soft Palate	2%
	Pharyngeal wall	2%

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

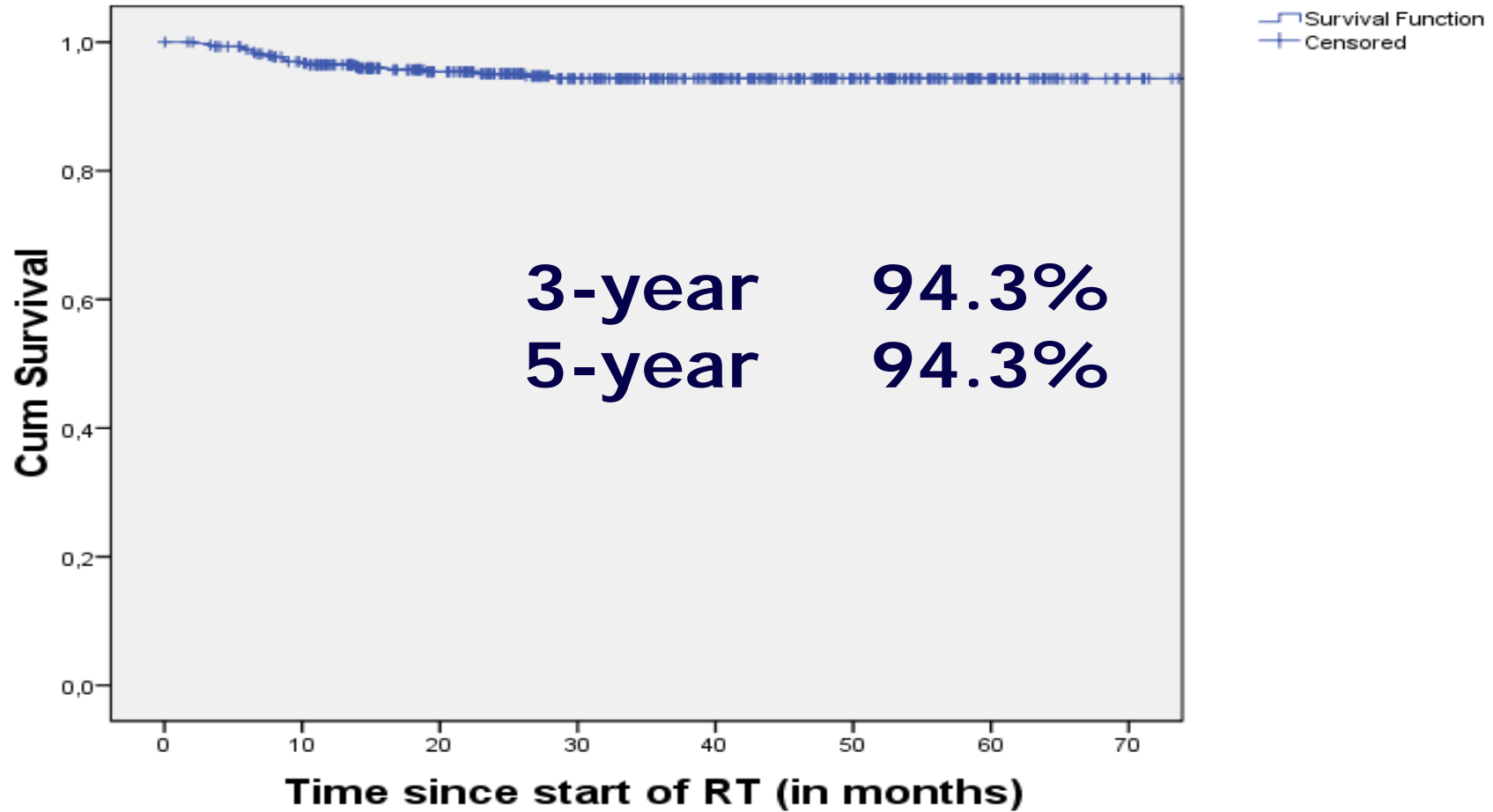
Stage III 19%, Stage IV 76% (91% received chemotherapy

Oropharyngeal Ca: IMRT (n=445)

Local Control



Regional Control



OS, DMFS and Statistics

OS : 3 years 84.9%
5 years 78.7%

DMFS : 3 years 87.1%
5 years 85.2%

	Univariate (Logrank)		Multivariate (Cox)	
	T1/2 vs T3/4	N0/1 vs N2/3	T1/2 vs T3/4	N0/1 vs N2/3
OS	p < 0.0001	p = 0.005	p < 0.0001	p = 0.009
LC	p = 0.05	NS	-	-
RC	NS	NS	-	-
DM	p = 0.01	p = 0.001	p = 0.01	p = 0.02

NS: Site, Age, Treatment Modality, Histology

IMRT for oropharynx: available data

Author	Year	# of Pt	Median FU (mo)	Definitive (%)	Stage III-IV (%)	Chemo (%)	Local and/or Regional Control (years)	OS % (years)
Chao	2004	74	33	42	93	27	LRC : 87 (4)	87 (4)
de Arruda	2006	50	18	96	92	86	LC:98 RC:88 (2)	98 (2)
Garden	2007	51	45	100	84	10	LRC: 93 (2)	94 (2)
Lawson	2008	34	20	100	94	100	LC: 92 RC:97 (2)	90 (2)
Sanguineti	2008	50	33	100	88	0	LC:94 RC:85 (3)	NA
Huang	2008	71	33	100	100	100	LC:94 RC:94 (3)	83 (3)
Daly	2009	107	27	79	96	87	LRC: 92 (3)	83 (3)
Eisbruch*	2009	69	32	100	0*	0*	LRF: 9 (2)	NA
MSKCC	2010	442	35	93	95	91	LF: 5 RF: 6 (3)	85 (3)

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!