



Akciğer Kanserinde Radyoterapi Teknikleri

Meriç ŞENGÖZ/ Ufuk ABACIOĞLU
Acıbadem Altunizade Hastanesi
Radyasyon Onkolojisi

Akciğer Kanserinde RT:



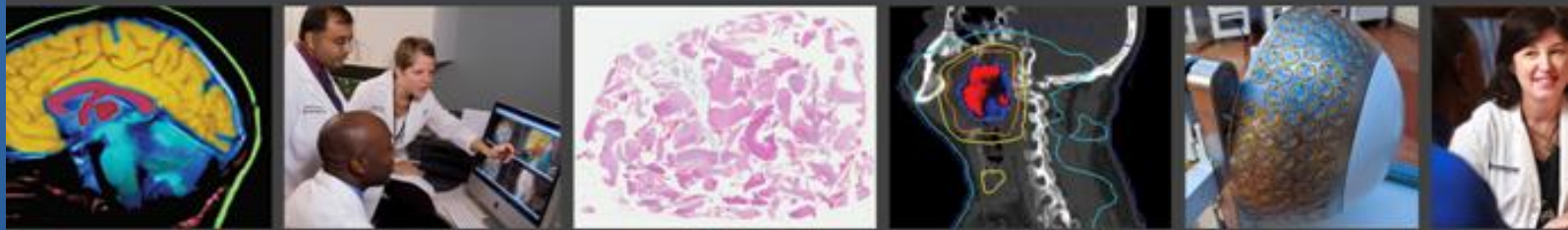
Histolojiye göre: Küçük hücreli dışı akciğer ca
Küçük hücreli akciğer ca

Amaca göre: Küratif RT
Adjuvant RT (post op)
Palyatif RT

Evreye göre: Erken evre SBRT
Lokal ileri evre Standart RT



RTOG
RADIATION THERAPY
ONCOLOGY GROUP



**Atlases for CT Gross Tumor Volume
(CTGTV) and PET Metabolic Tumor
Volume (PETMTV) for RTOG 1106**

Feng-Ming (Spring) Kong MD PhD,



Defining Target Volumes for Non-small Cell Lung Carcinoma

Suresh Senan,* Olivier Chapet,[†] Frank J. Lagerwaard,* and Randall K Ten Haken[†]

Defining target volumes for NSCLC

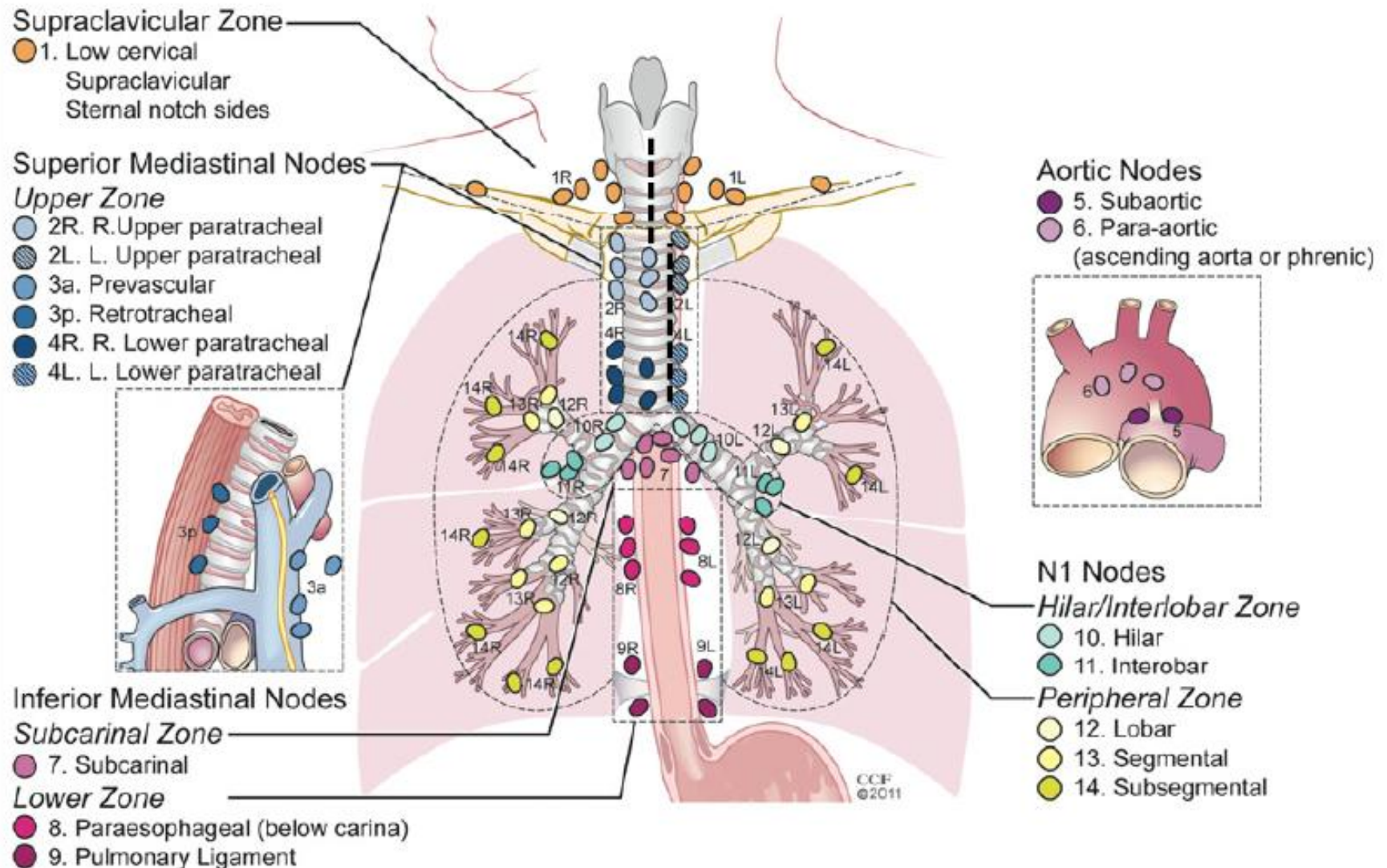
311

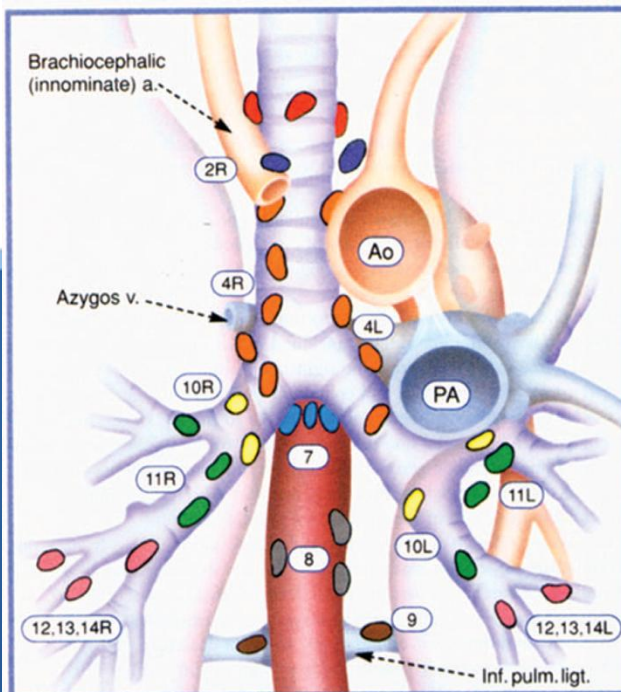
Table 1 Scheme for Defining the Mediastinal GTV for NSCLC

Nodal Diameter* and PET [†]	Action	Comment/Rationale
<1 cm PET +ve	Include in GTV	High positive predictive value of PET scan Only if a dedicated PET scan was used EUS-FNA has sensitivity of 88% and accuracy of 91%
<1 cm PET -ve	Exclude from GTV	
>1 cm PET +ve	Include in GTV unless repeated cytology of the node is negative	
>1 cm PET -ve and where no cytology is available	Include in GTV if primary tumor is PET negative If primary tumor shows PET uptake, exclude node from GTV unless cytologically positive	

*Diameter in short-axis.

[†]Using a dedicated PET scanner.





Superior Mediastinal Nodes

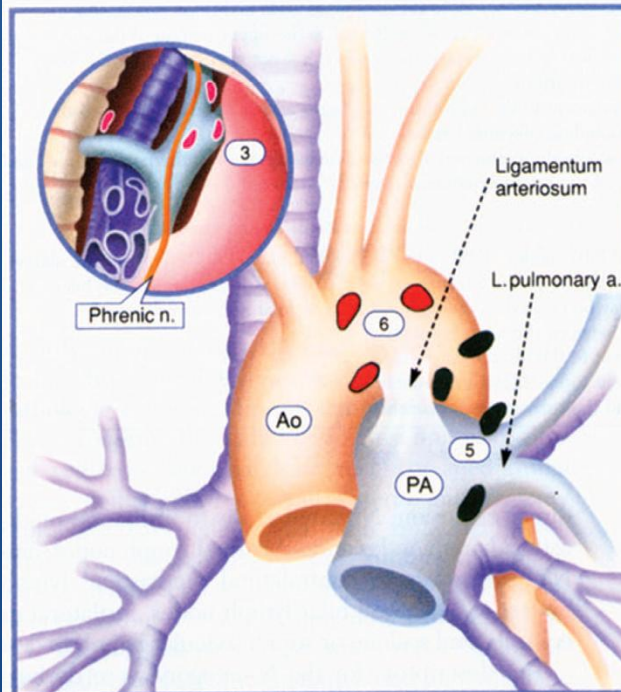
- 1 Highest Mediastinal
- 2 Upper Paratracheal
- 3 Pre-vascular and Retrotracheal
- 4 Lower Paratracheal (including Azygos Nodes)

N₂ = single digit, ipsilateral

N₃ = single digit, contralateral or supraclavicular

Aortic Nodes

- 5 Subaortic (A-P window)
- 6 Para-aortic (ascending aorta or phrenic)

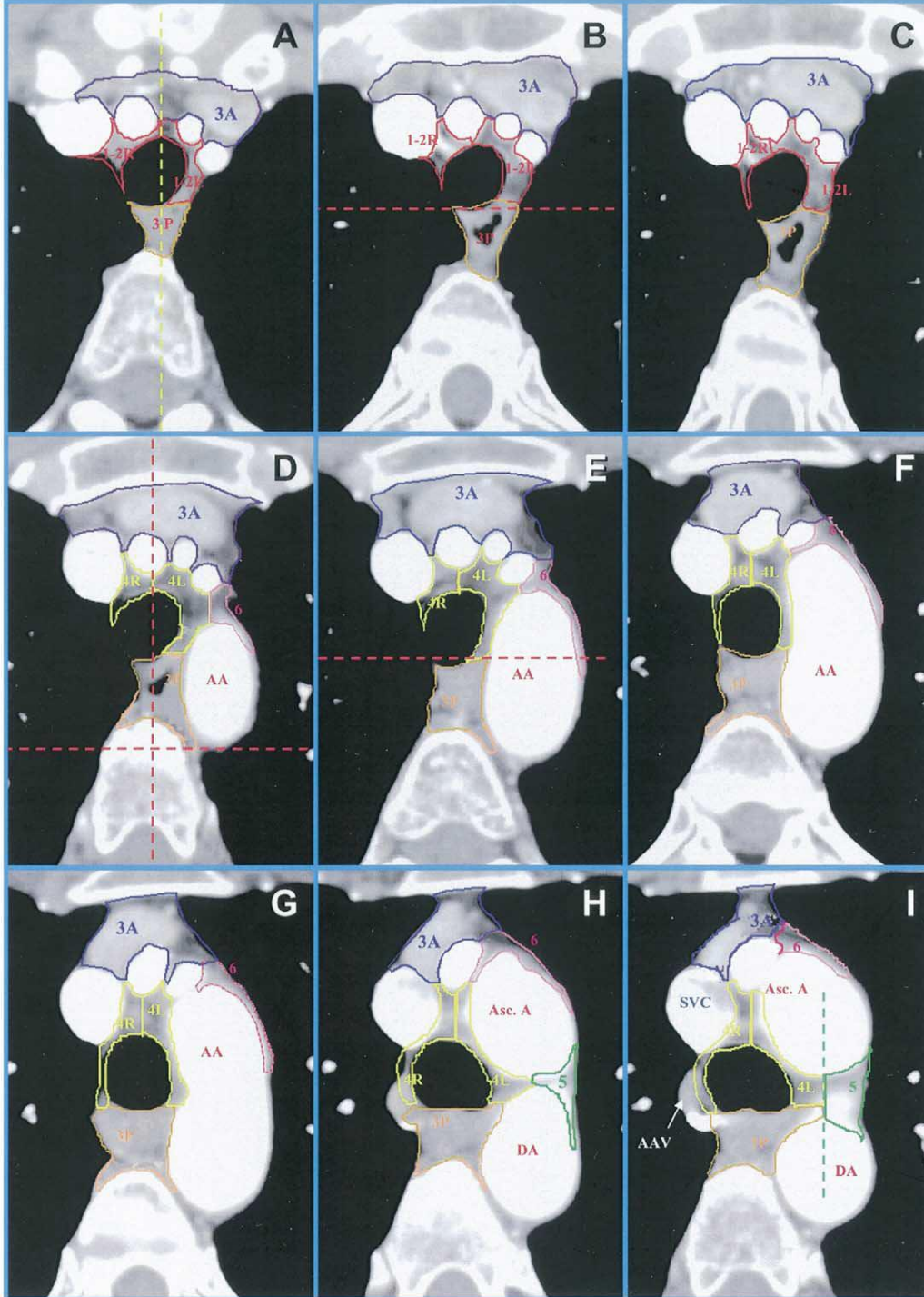


Inferior Mediastinal Nodes

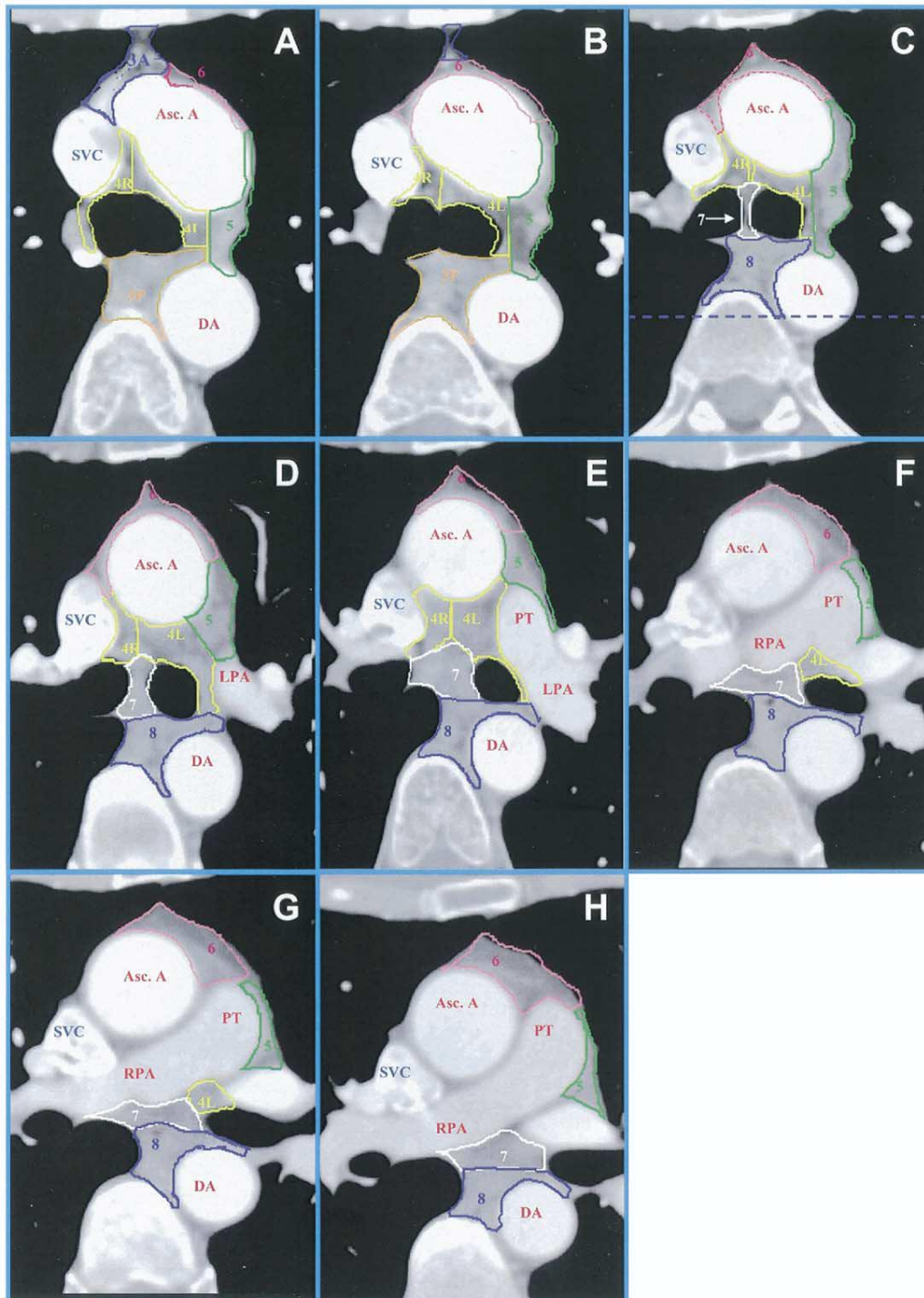
- 7 Subcarinal
- 8 Paraesophageal (below carina)
- 9 Pulmonary Ligament

N₁ Nodes

- 10 Hilar
- 11 Interlobar
- 12 Lobar
- 13 Segmental
- 14 Subsegmental



- (A) Sternal notch is beginning of delineation of stations 1–2R and L and 3A and 3P. Yellow dotted line separates 1–2R from 1–2L.
- (B) Posterior limit of 1–2R and L defined by red dotted line.
- (C) Inferior limit of 1–2R and L.
- (D) Top of aortic arch (AA). First slice with Stations 4R, 4L, and 6. Vertical red dotted line, midline of trachea separating 4R from 4L. Horizontal dotted line 1 cm posterior to anterior border of vertebral body delimiting posterior limit of 3P.
- (E) Posterior limit of 4R and L (red dotted line).
- (F,G) Left brachiocephalic vein still included in Station 3A.
- (H) Most inferior aspect of AA. Superior limit of Station 5. Asc. A ascending aorta; DA descending aorta.
- (I) Midline between Asc. A and DA separating Stations 4L and 5. SVC superior vena cava



(A) Station 5 extending at midpoint of ascending aorta. (Asc. A). SVC superior vena cava; DA descending Aorta.

(B) Inferior limit of Stations 3A and 3P.

(C) Carina. Superior limit of Stations 7 and 8. Blue dotted line 1 cm posterior to anterior border of vertebral body defines posterior limit of Station 8.

(D) Midline between left pulmonary artery and ascending aorta defining limit between Stations 4L and 5. LPA left pulmonary artery.

(E) Station 8 covering anterior border of DA. PT pulmonary trunk.

(F) Right pulmonary artery (RPA) crossing mediastinum. Inferior limit of Station 4R.

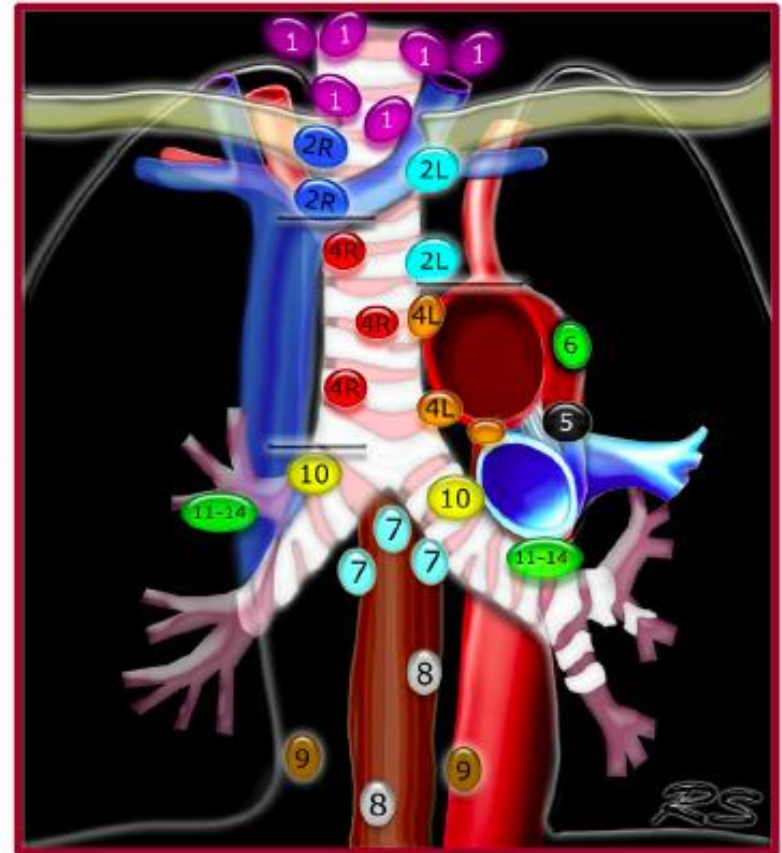
(G) Inferior limit of 4L.

(H) Lowest image in which RPA is maximally visualized

Diagnostic Workup: Methods for staging mediastinum

Mediastinal LN Biopsy

	Lymph Node Levels							
	2	4	5	6	7	8-9	10	
EBUS-FNA	✓	✓			✓		✓	
EUS-FNA		✓			✓	✓		
Mediastinoscopy: Cervical	✓	✓			✓		✓	
Mediastinoscopy: Chamberlain		✓	✓	✓	✓			



Set-up ve Simülasyon



- Immobilizasyon
 - T-board, Wing-board
 - Vakum yatak
- Pozisyon
 - Kollar yukarıda vs aşağıda
 - (Tümörün yerleşimine göre)
 - Supin vs pron
 - Hastanın rahatlığı çok önemli!!

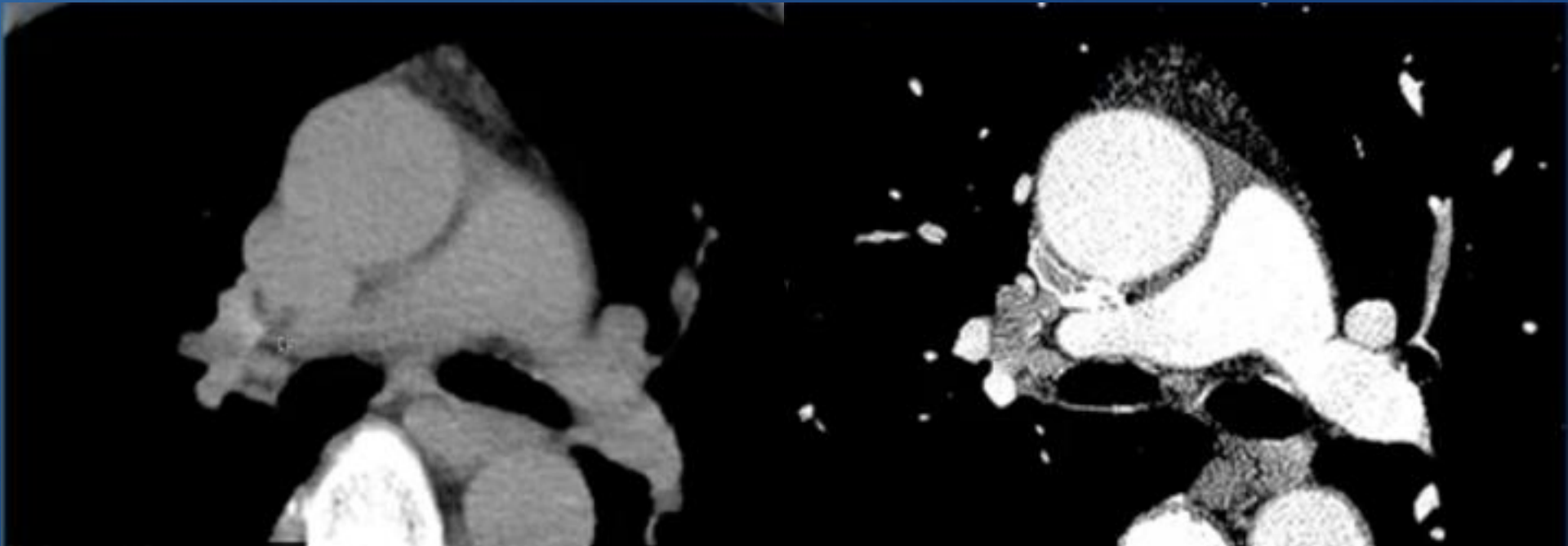


C1-2'den L2'nin altına kadar
2-3 mm kesit kalınlığı

IV Kontrast?



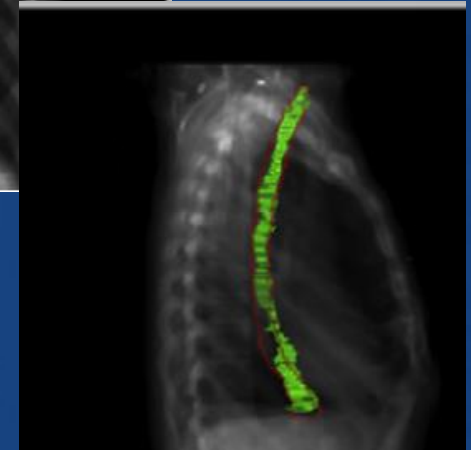
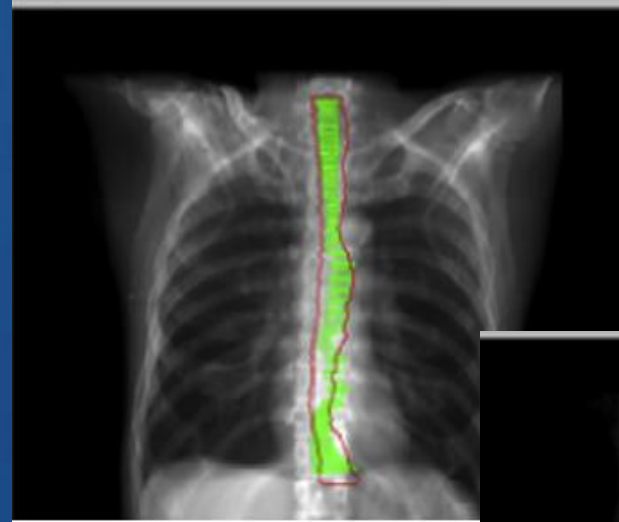
- Mediastene veya hilusa komşu tümörlerde faydalı
- En geç 2 hafta öncesine ait kontrastlı diagnostik CT varsa kullanılabilir



Özofagus oral kontrast?



- Yüksek yoğunluklu oral kontrastın dozimetrik etkisi
 - Dilüe kontrast
- Özofagus'un hacmini ve şeklini değiştirebilir (daha uzun ve geniş)



Kontrastlı (kırmızı) hacim 80 cc
Kontrastsız (yeşil) 47 cc



● CT

- Parenkimal GTV için AC penceresi
- Mediasten/yumuşak doku penceresi mediastene komşu tümörlerde

● FDG-PET

- Atelektaziyi ayırt etmek için yararlı

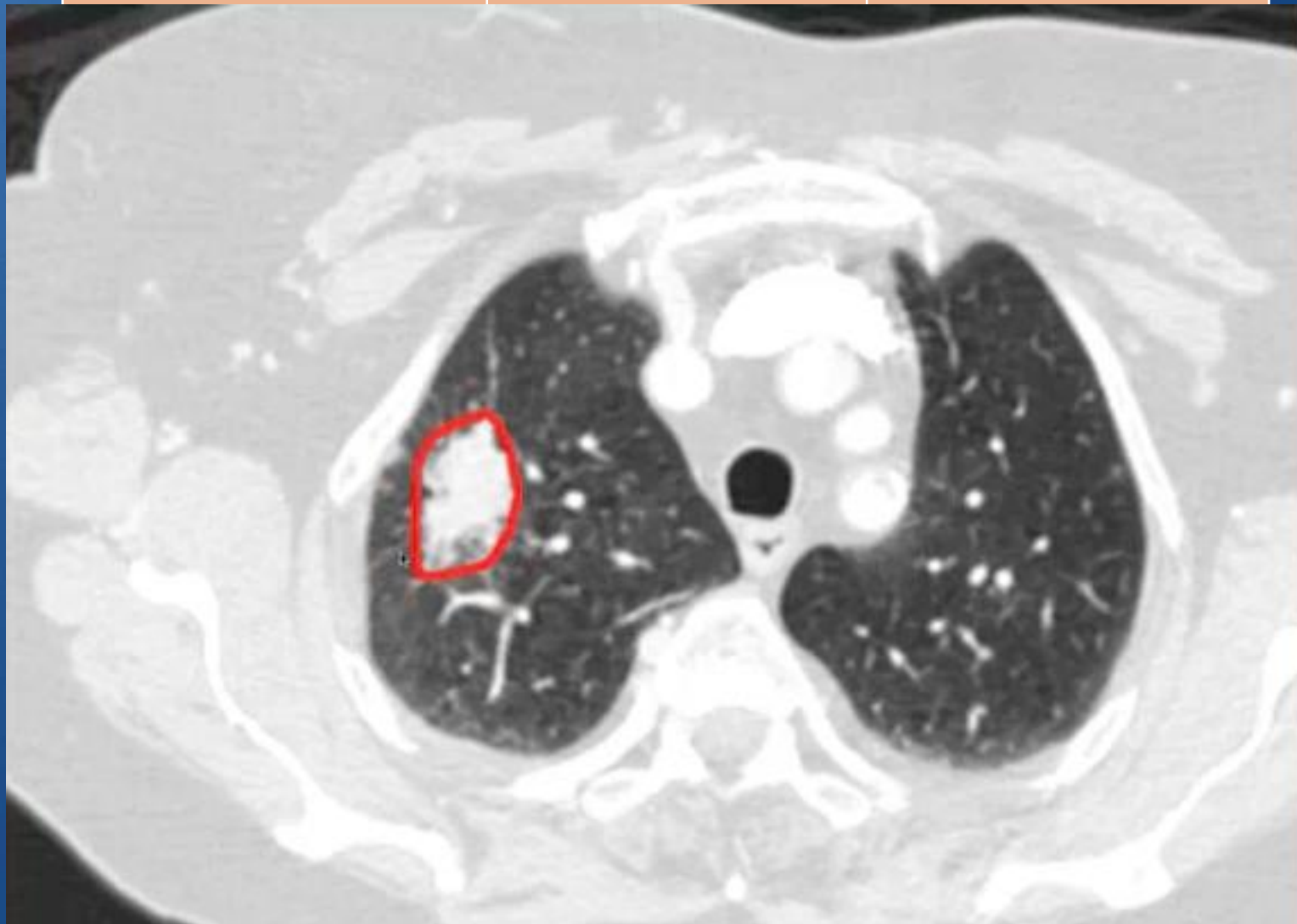
● 4-D CT

- Solunum kontrolü stratejisini belirlemek için
 - MIP-ITV
 - Nefes Tutma
 - Gating

	Width	Level
Mediastinum	400	20



	Width	Level
Parenchyma	1600	-600



Konturlama

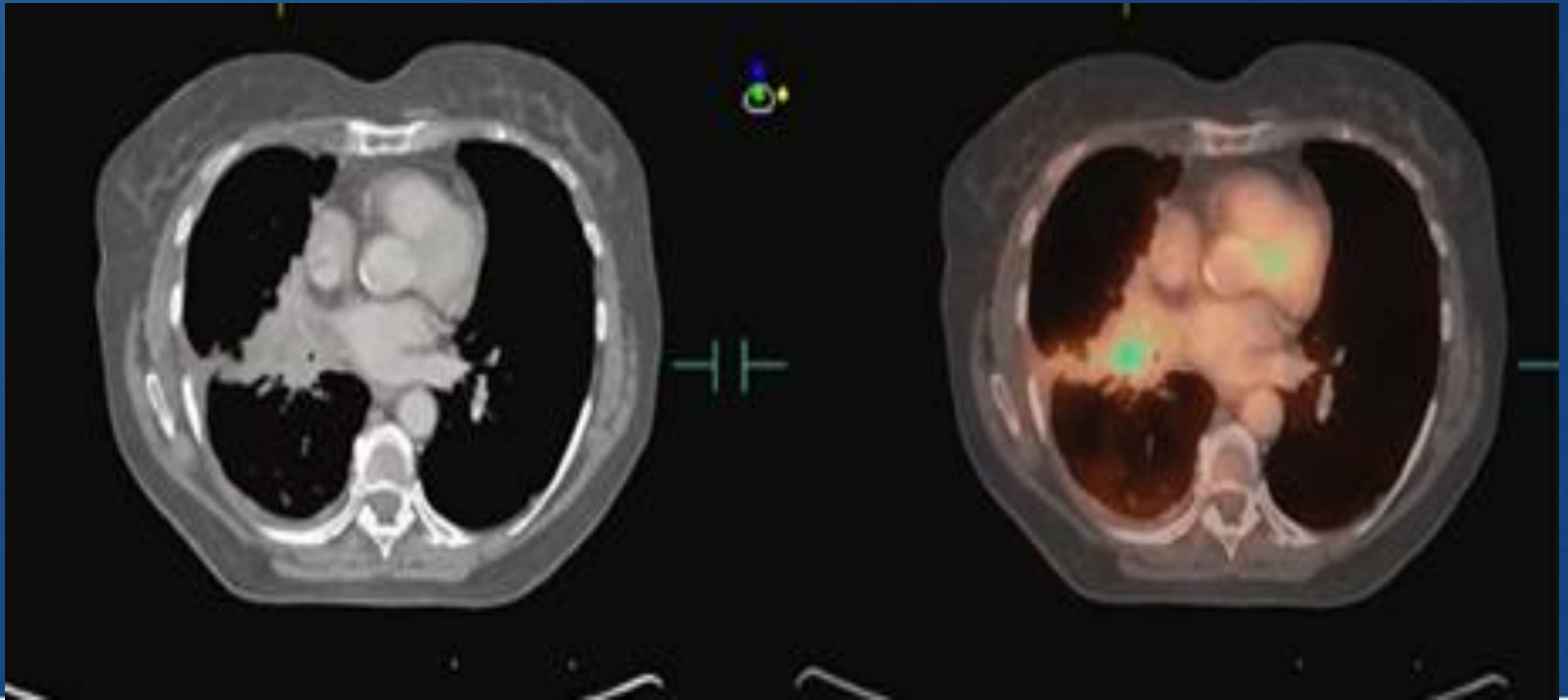


- Spiküler uzanım koronal ve sagittal kesitlerden de takip edilir
- Vasküler yapılar takip edilir (damarlar dallanır!)
- Viseral plevra aşılmaz

PET ile GTV kontrolama



- GTV'yi atelektazi veya efüzyondan ayırmak için



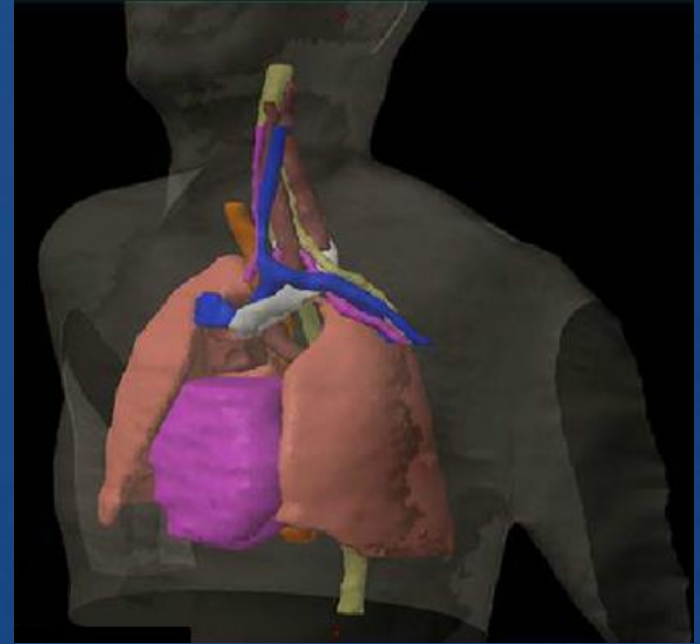


- Serbest Solunum (4-D CT)
 - ITV (MIP Maximum Intensity Projection) +3-5 mm
- Nefes Tutma (DIBH)
 - GTV + 5 mm
- Gating (Belirlenen fazda ışınlama)
- Tracking (Tümörün hareketini takip etme)

OAR Kontrolama



- Akciğer
- Santral Akciğer Havayolu
- Kalp
- Spinal kord
- Özofagus
- Brakial Plexus



Akciğer Konturlama

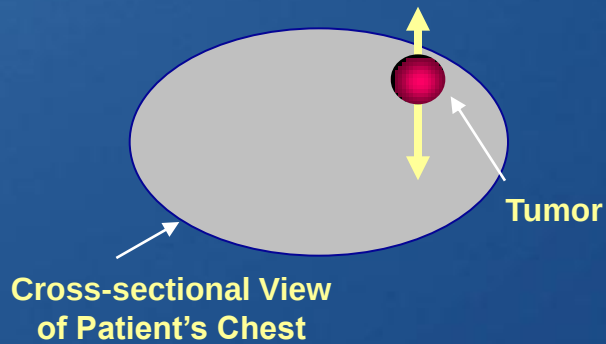
- Tüm akciğer dokusu konturlanır (atelektazi dahil)
- GTV dışlanır
- Santral havayolu ve efüzyon dışlanır
- Sağ ve sol akciğer ayrı ayrı konturlanır, dozimetrik hesaplama için tüm akciğer ayrıca tanımlanır.



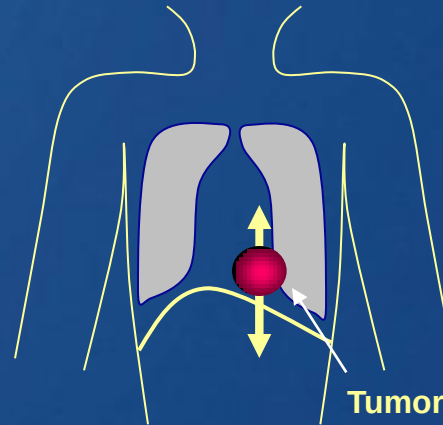
4. BOYUT ORGAN HAREKETLERİ



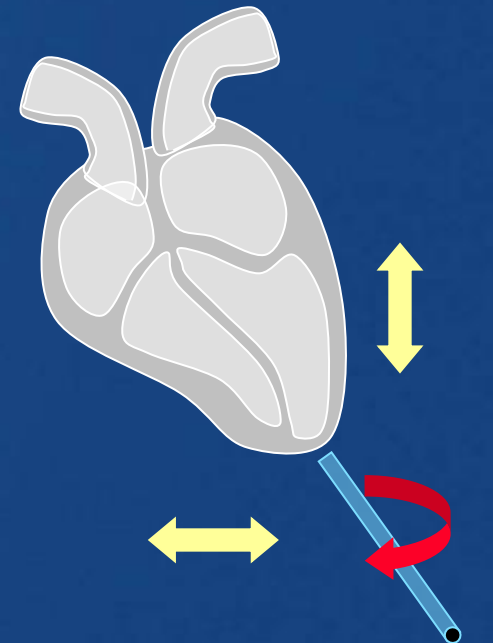
?



Some motion is mostly
Anterior / Posterior



Some motion is mostly
Superior / Inferior



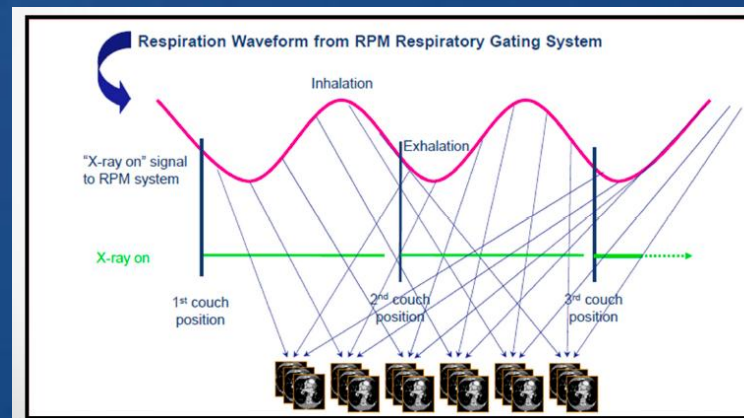
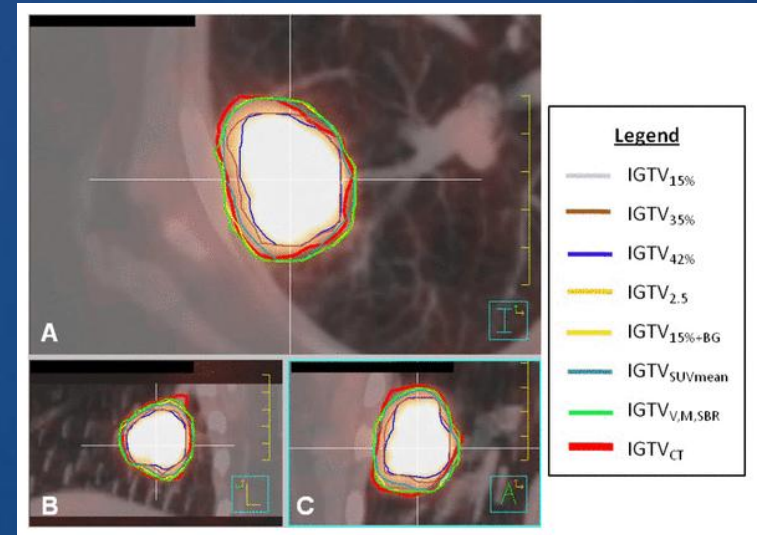


- Yavaş CT
- 4-D CT (ITV)
- Breath Hold (derin insp)
- Abdominal kompresyon
- Respiratory Gating (end-exhale)
- Tracking
- Serbest Solunum
- 4-D CT (10 faz)
 - Average (konturlama)
 - MIP (ITV)

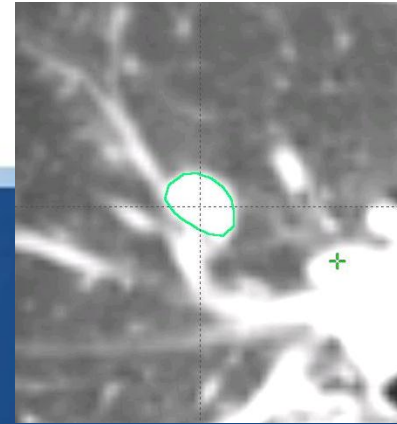
Hareket Yönetimi

● Solunum Kontrolu

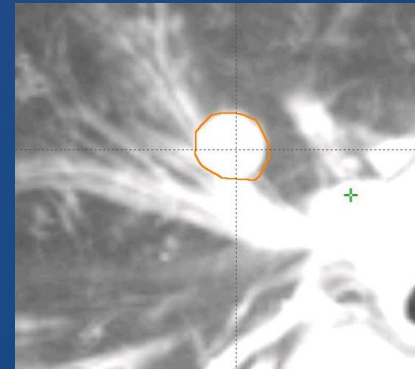
- 4-D CT, MIP
- Breath Hold
- Gating
- Tumor Tracking



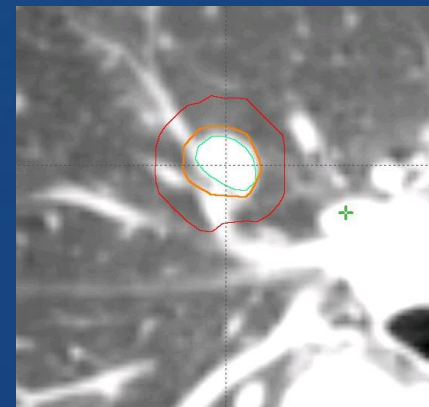
4-D CT



GTV



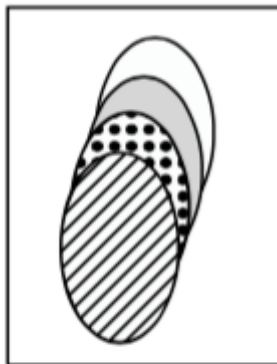
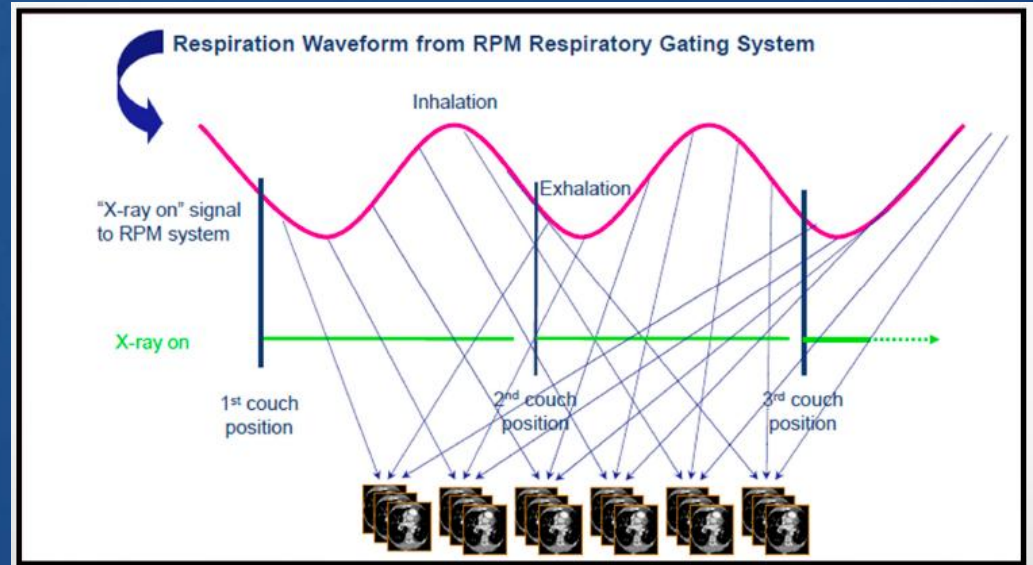
ITV (MIP)



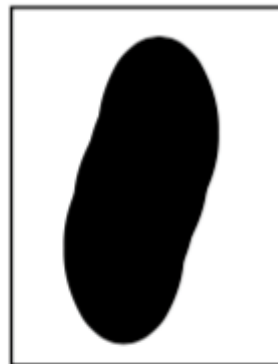
PTV



4-D CT



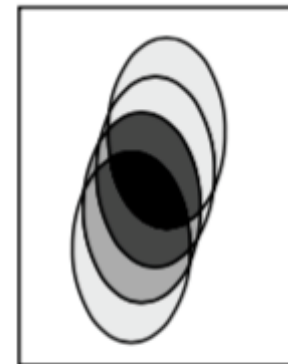
Separate
phase



MIP



MinIP



Average