Contouring, Target Volume Delineation, 3D CT Based Planning Of BCT and Plan Evaluation

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BACKGROUND

Steps of Radiotherapy planning

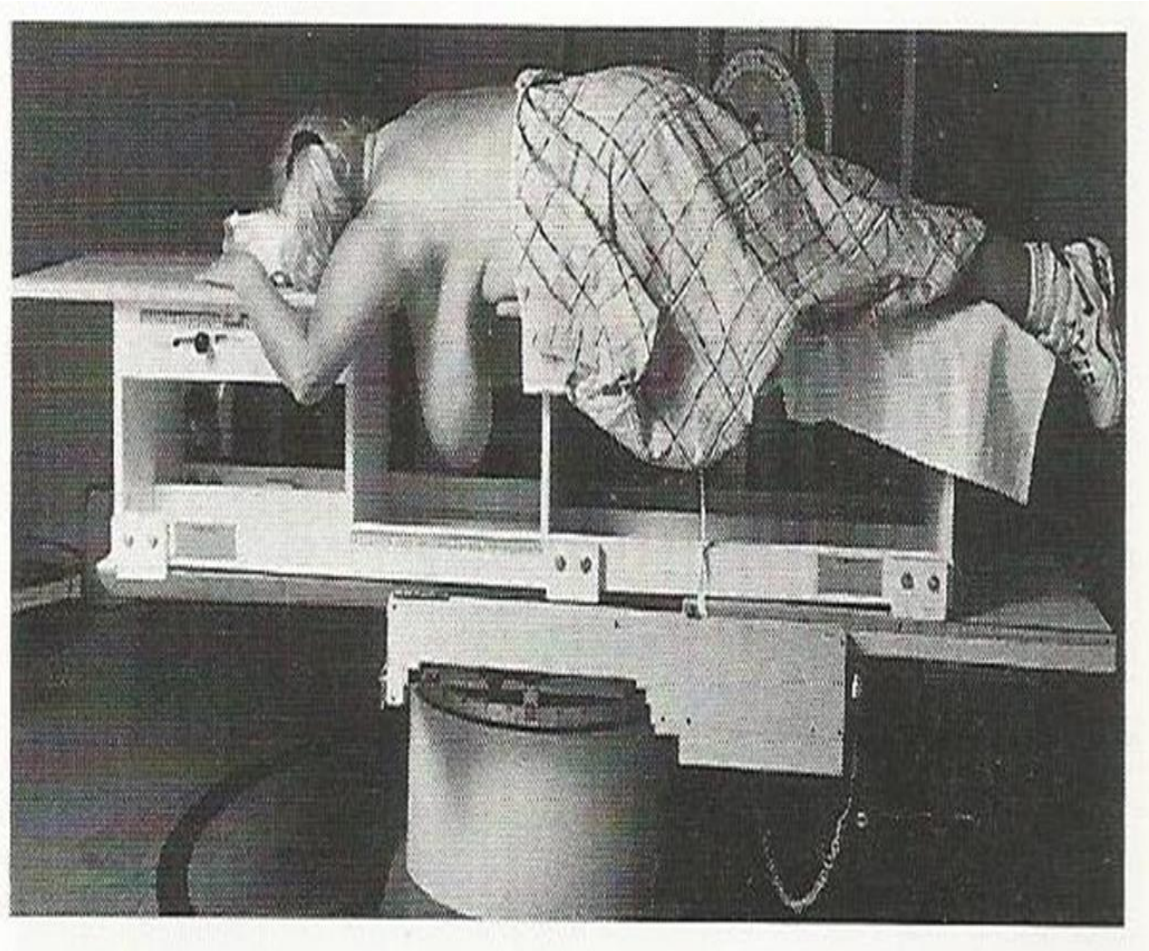
- Positioning using immobilization device
- Simulation
- Target Volume Delineation
- Treatment Planning
- Dose & Fractionation

Positioning using immobilization device

Why breast board ?

- Adjustable features allow for the manipulation of patients arms, wrists, head & shoulders.
- Make chest wall surface horizontal
- Arms do not obstruct lateral beams
- Thermoplastic breast support can be added for immobilization of large pendulous breast

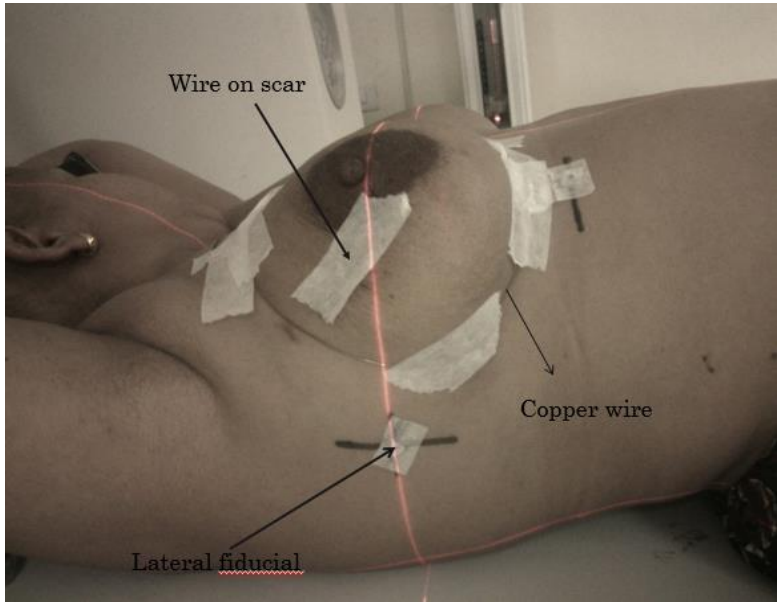
Prone position not routinely practised

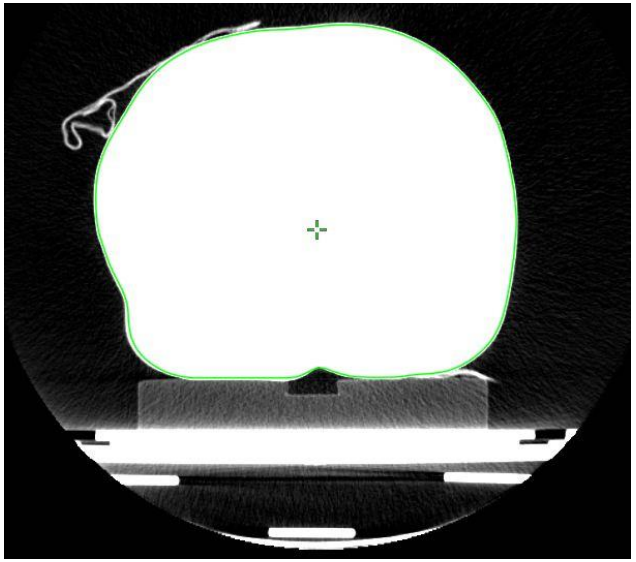


- Advantages vs disadvantages

Simulation

- NCCT / CECT thorax for Radiotherapy Planning (RTP)
  - Flat Couch, Slice Thickness (3mm), Full body Contour, 3 fiducial markers visible in single slice
- Clinical reference mark using radiopaque wires (scars, field borders, breast tissue)





Courtesy- last ICRO slides (Dr. Ashwani Budrukar)

Road Map

SECTION-A

Contouring, Target Volume Delineation

- Chapter 1: Breast
- Chapter 2: Breast & Chestwall
- Chapter 3: Chestwall
- Chapter 4: SCF
- Chapter 5: Axillary Nodes

SECTION- B

3D CT Based Planning

- Chapter 6: Planning techniques

SECTION- C

Plan Evaluation

- Chapter 7: Dose Volume Histograms

BACKGROUND

- Knowledge of Surface Anatomy, 3D Anatomy, Radiological Anatomy of structures enumerated in RTOG Guidelines

SECTION-A
CONTOURING, TARGET VOLUME DELINEATION

Chapter 1: Breast

Breast Cancer Atlas for Radiation Therapy Planning: Consensus Definitions

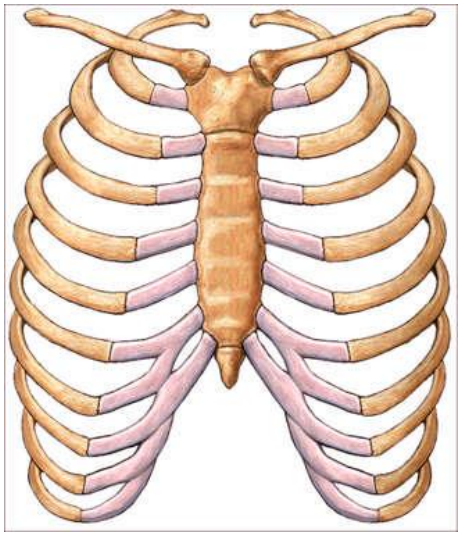
RTOG
RADIATION THERAPY ONCOLOGY GROUP

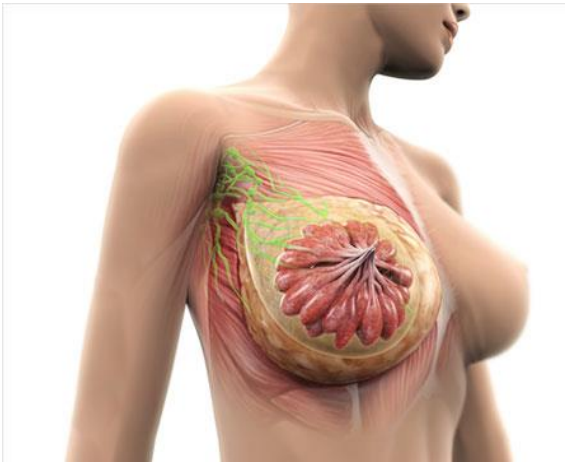
Breast and Chestwall Contour: Anatomical Boundaries

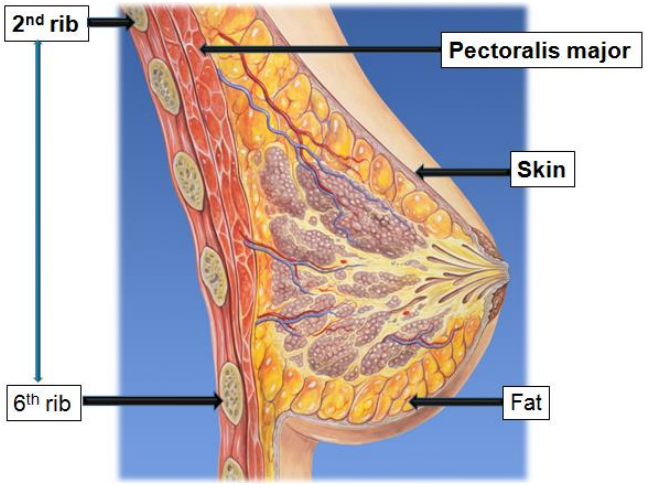
	Cranial	*Caudal*	*Anterior*	*Posterior*	*Lateral*	*Medial*
Breast[1]	Clinical Reference + Second rib insertion[a]	Clinical reference + loss of CT apparent breast	Skin	Excludes pectoralis muscles, chestwall muscles, ribs	Clinical Reference + mid axillary line typically, excludes latissimus (Lat.) dorsi m. [b]	Sternal-rib junction [c]
Breast + Chestwall[2]	Same	Same	Same	Includes pectoralis muscles, chestwall muscles, ribs	Same	Same
Chestwall[3]	Caudal border of the clavicle head	Clinical reference+ loss of CT apparent contralateral breast	Skin	Rib-pleural interface. (Includes pectoralis muscles, chestwall muscles, ribs)	Clinical Reference/ mid axillary line typically, excludes lattismus dorsi m [a]	Sternal-rib junction [b]

RECALL ANATOMY

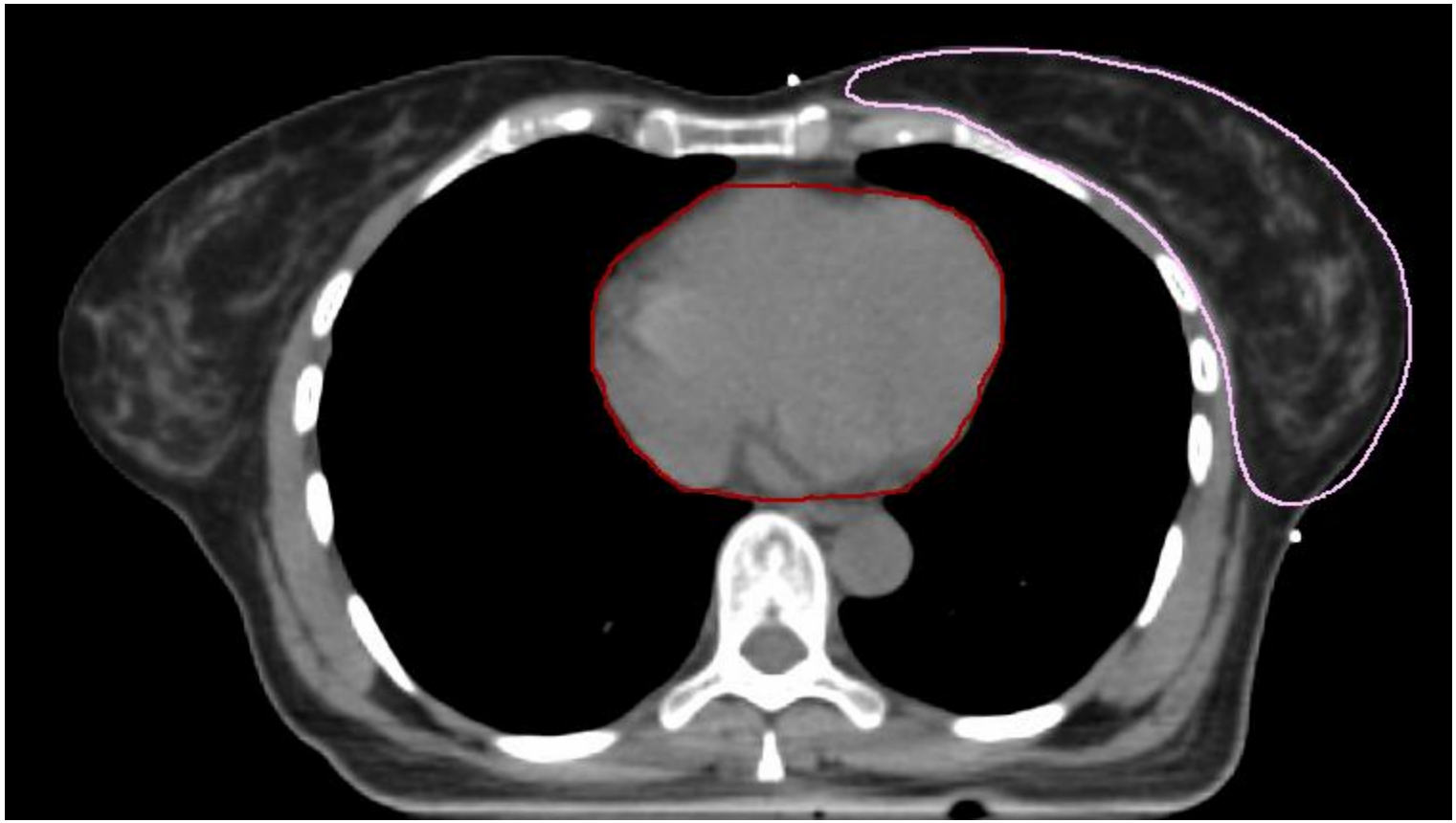
Cranial, Caudal Borders

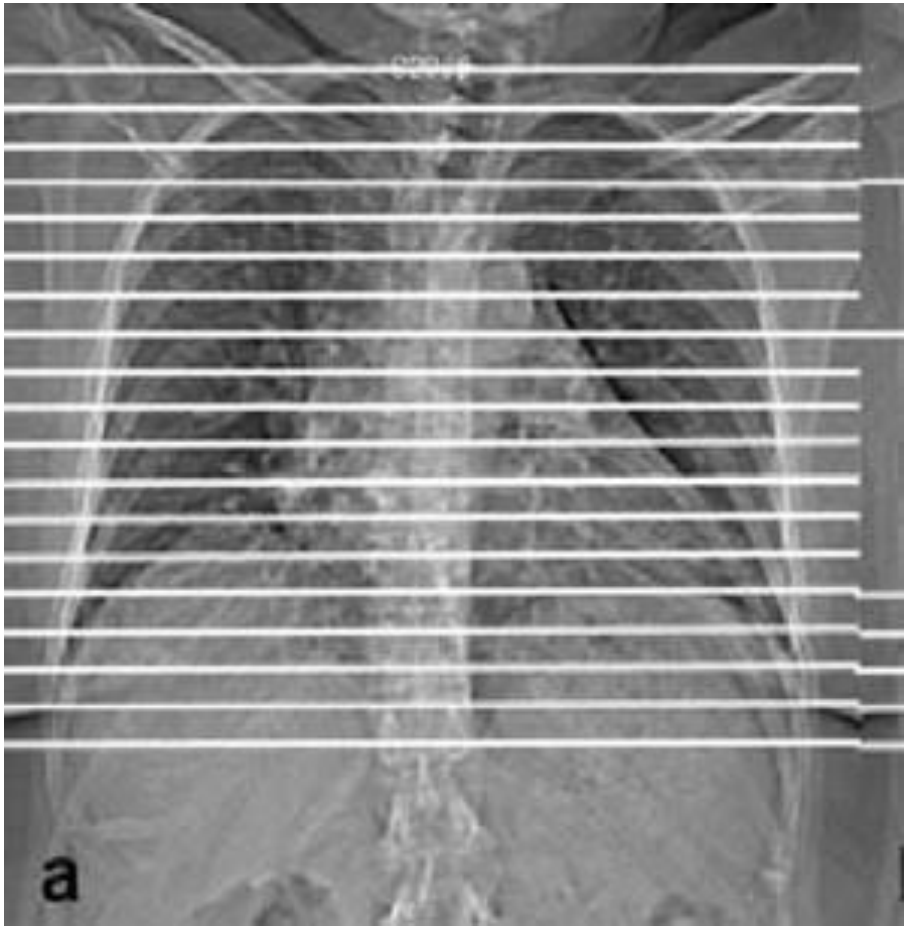






Step 1: Recall the anatomy (Surface, 3 Dimensional and Radiological)

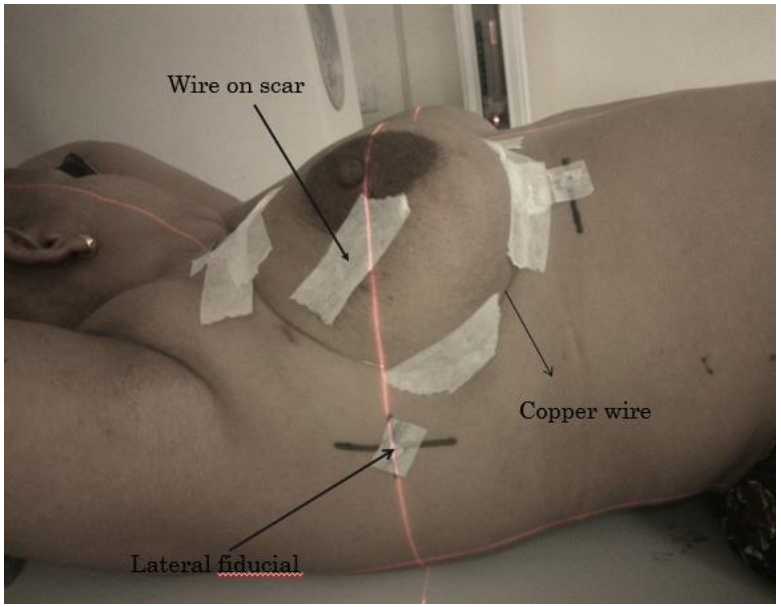




Step 2: Identify the number of sections in which you need to delineate that structure (Cranial to Caudal)

Cranial & Caudal

- Clinical reference- Reciprocated by Wires
- Use copper wires to reduce artefacts



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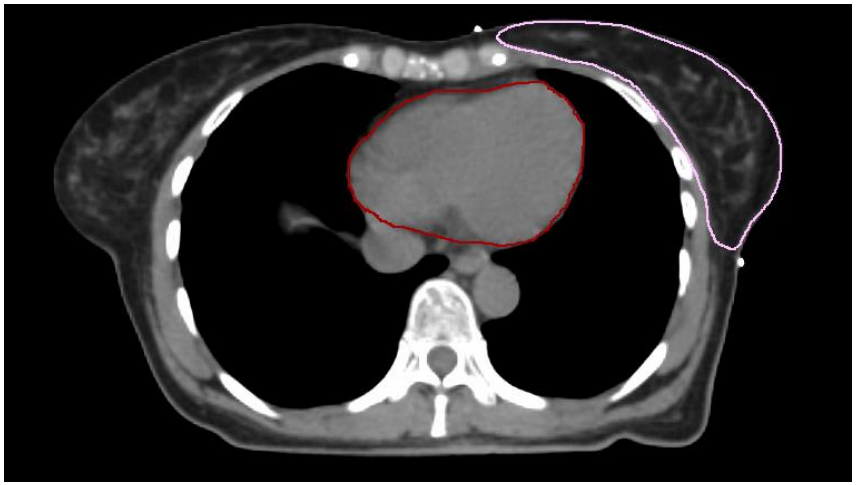
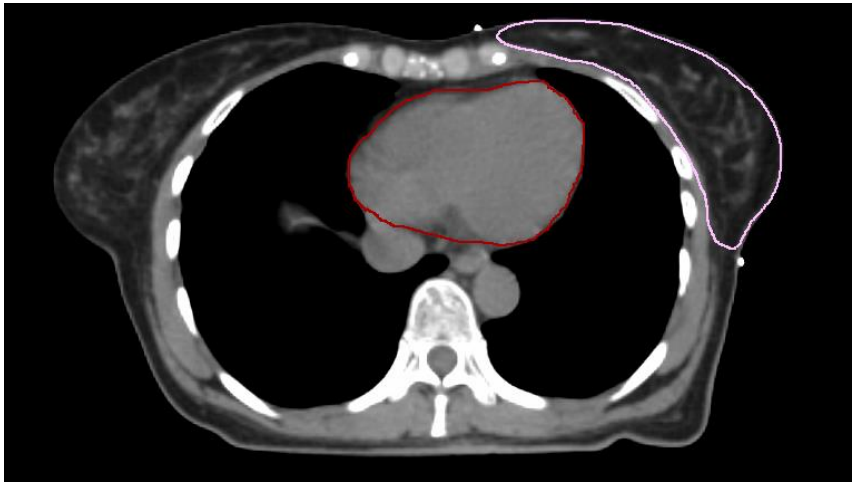
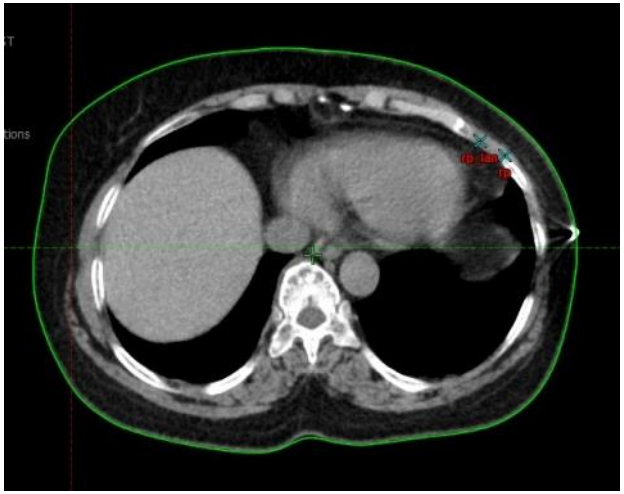
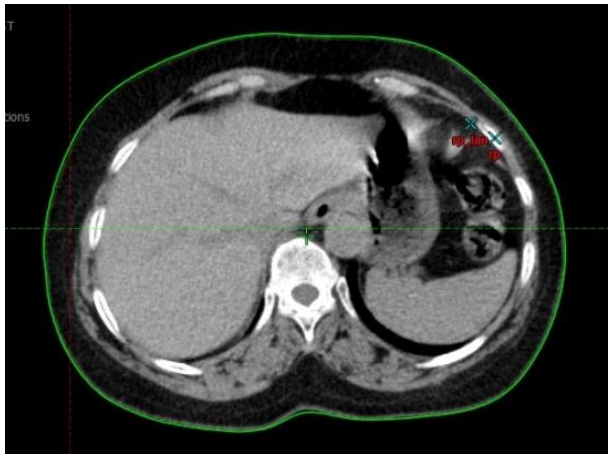


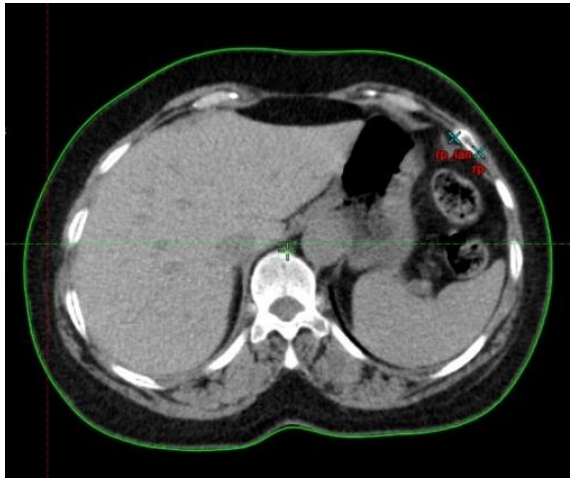


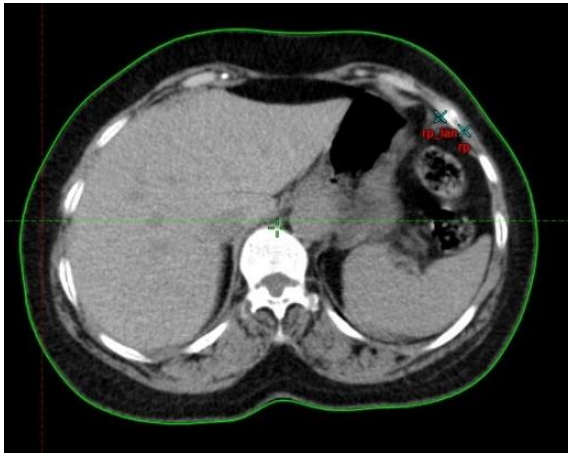
Step 3: Start delineation around the middle of the bundle of sections selected, first towards cranial/ caudal and then in the opposite direction. Verify caudal limit in sagittal sections

Moving Caudally

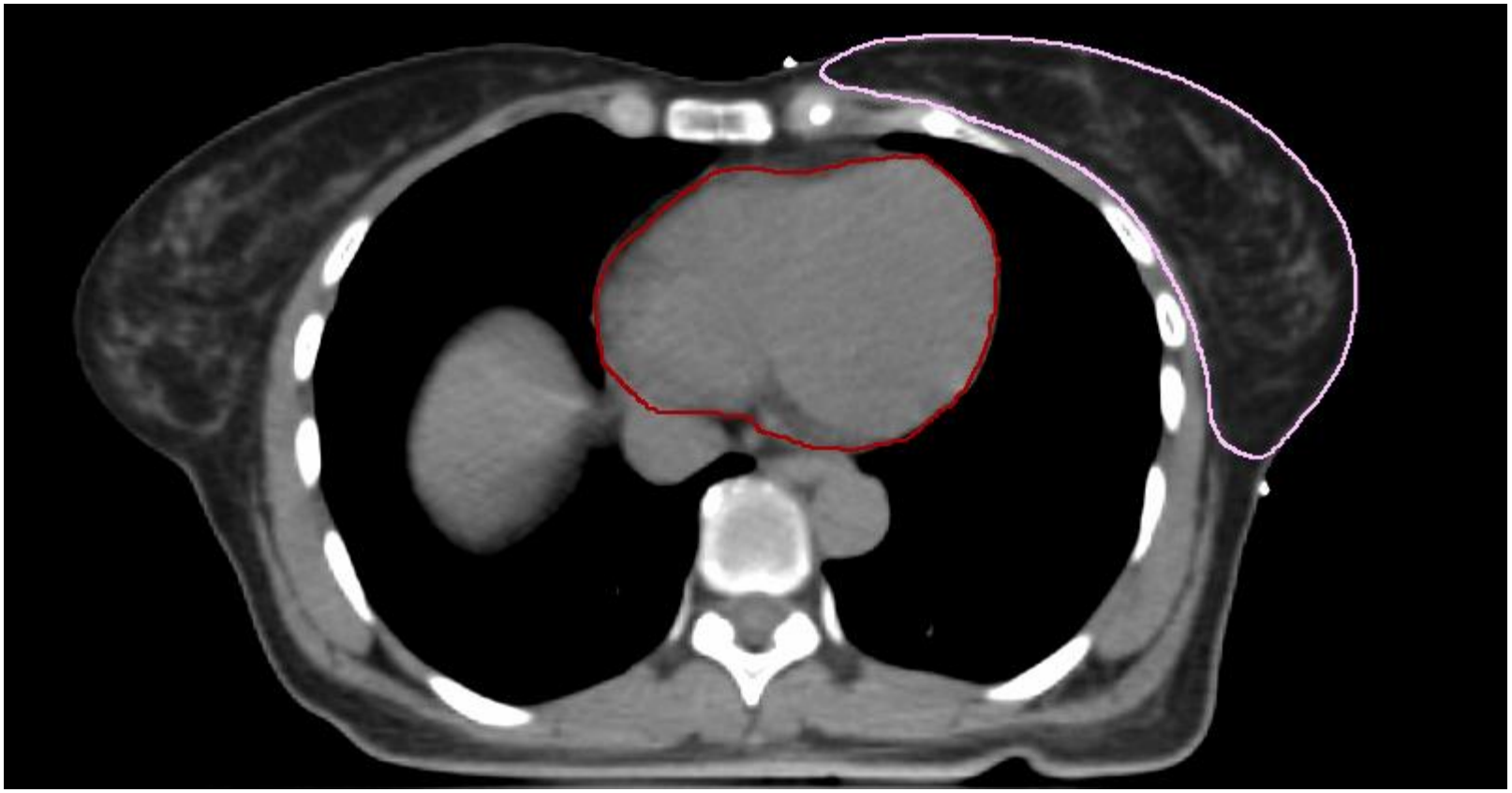








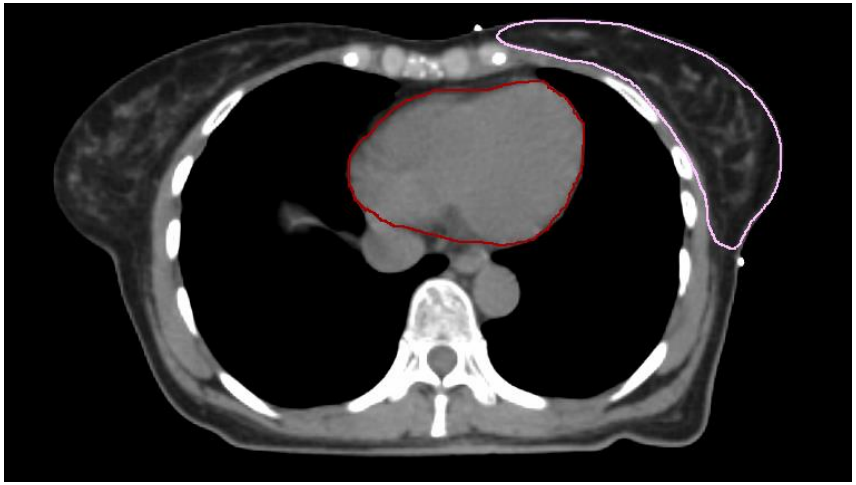
Anterior, Posterior, Medial & Lateral

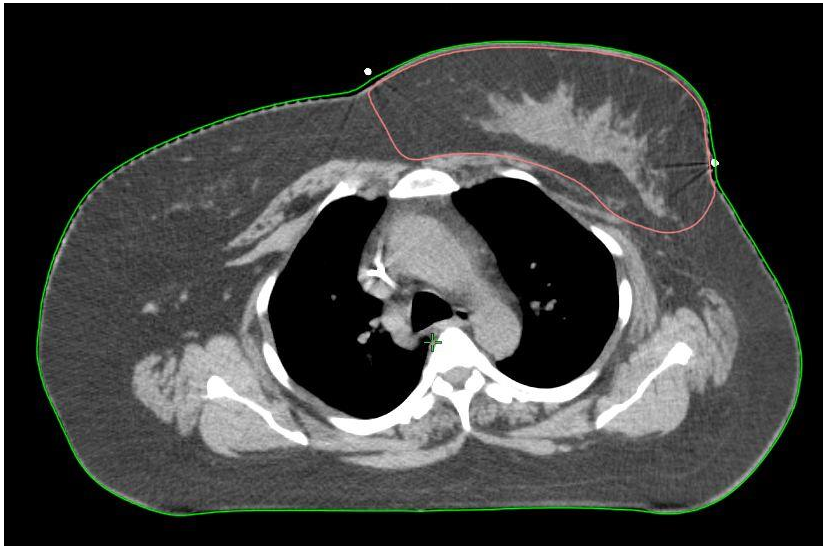


Step 4: In each section identify the structures limiting the delineation in rest of the 4 directions (Anterior, Posterior, Medial and Lateral)

Practical Case

- Not so good breast contours as you see in guidelines !



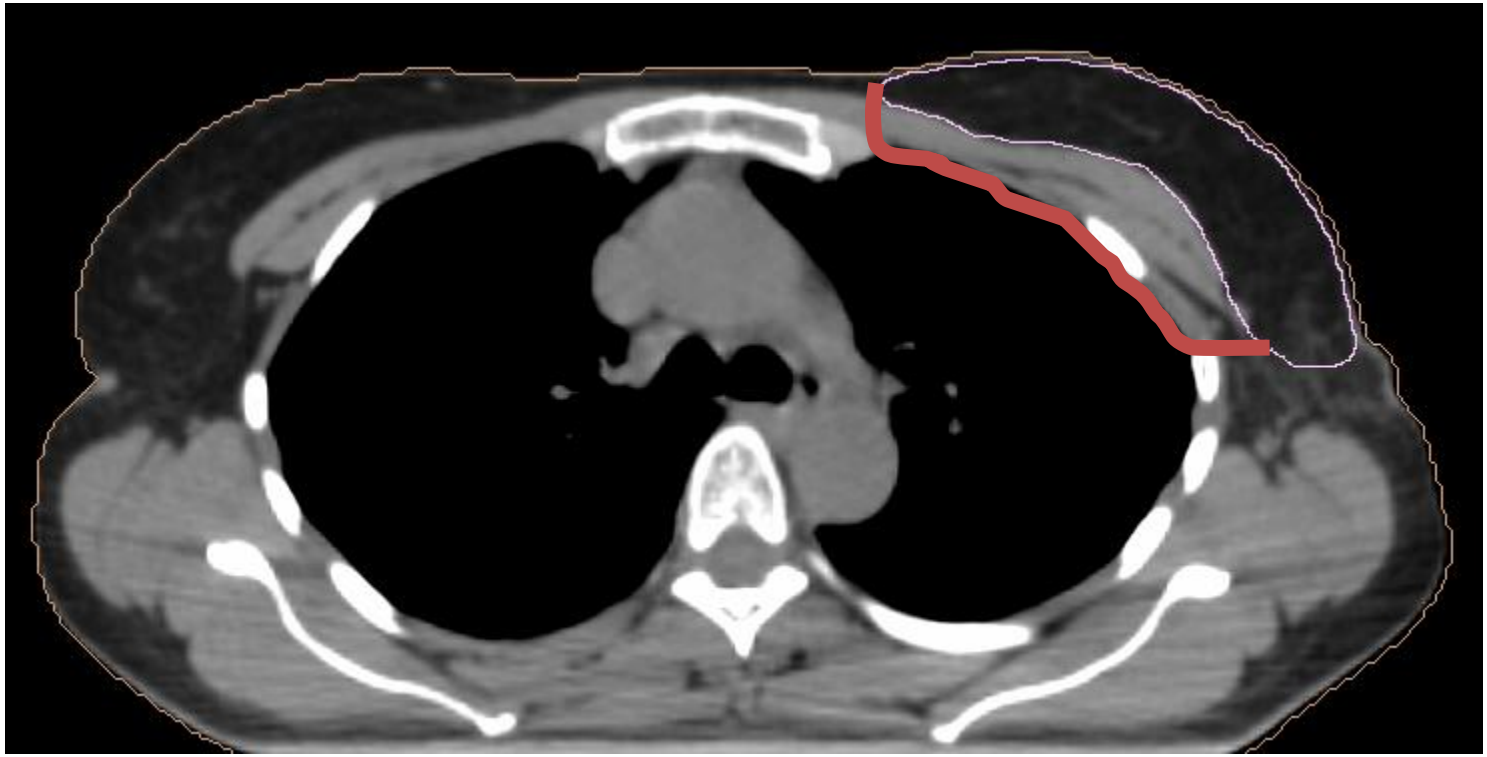


- Step 5: After complete delineation, review the complete delineation as a structure existing in the body to see whether it is fitting into your knowledge of anatomy (3-dimensional/ Surface/ Radiologically)
- Step 6: Once you have delineated all the structures, get it verified from your colleague
  - (Remember he/ she is your best judge, and not your faculty!)

SECTION-A
CONTOURING, TARGET VOLUME DELINEATION

Chapter 2: Breast & Chestwall

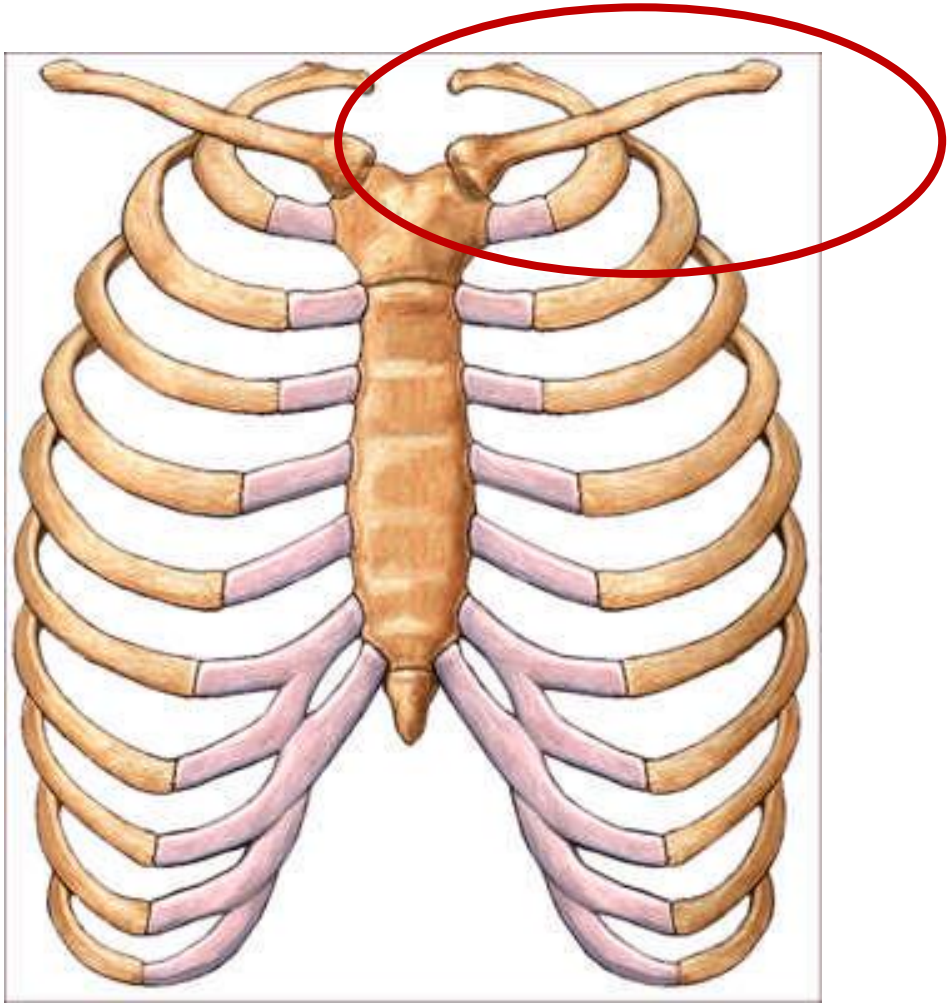
Breast & Chestwall



SECTION-A
CONTOURING, TARGET VOLUME DELINEATION

Chapter 3: Chest wall

Cranial



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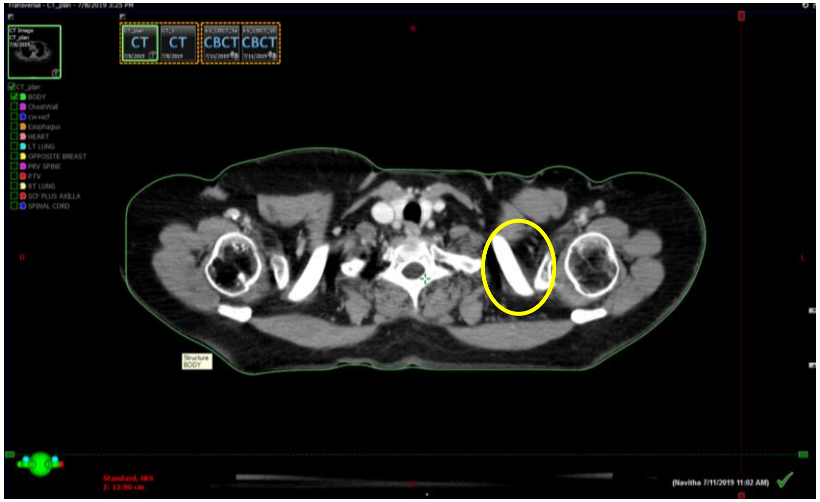
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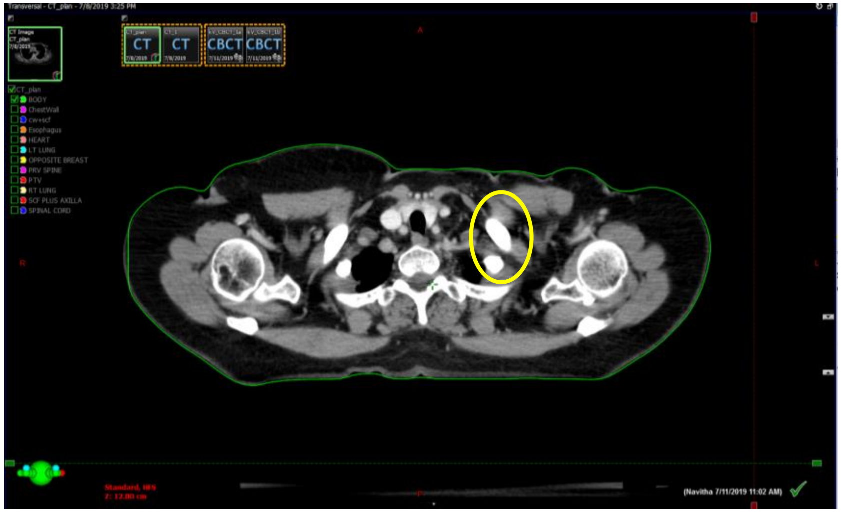
CT
CBCT
CBCT

CT
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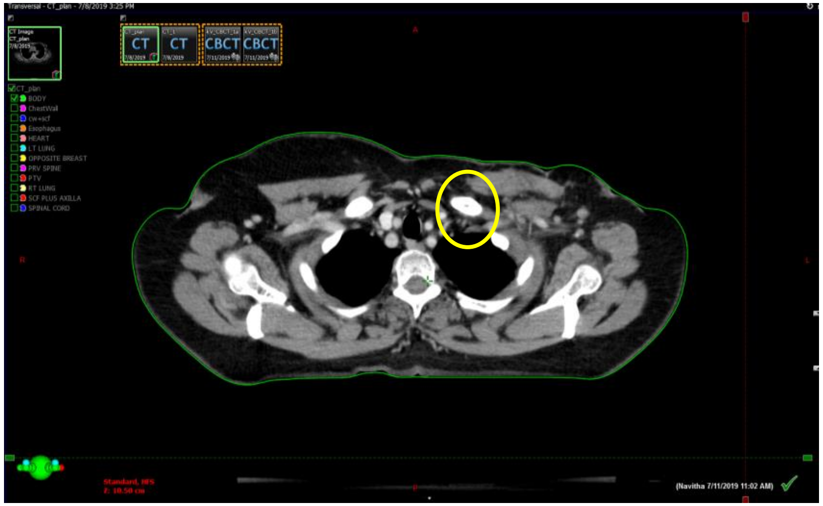
CT
CT
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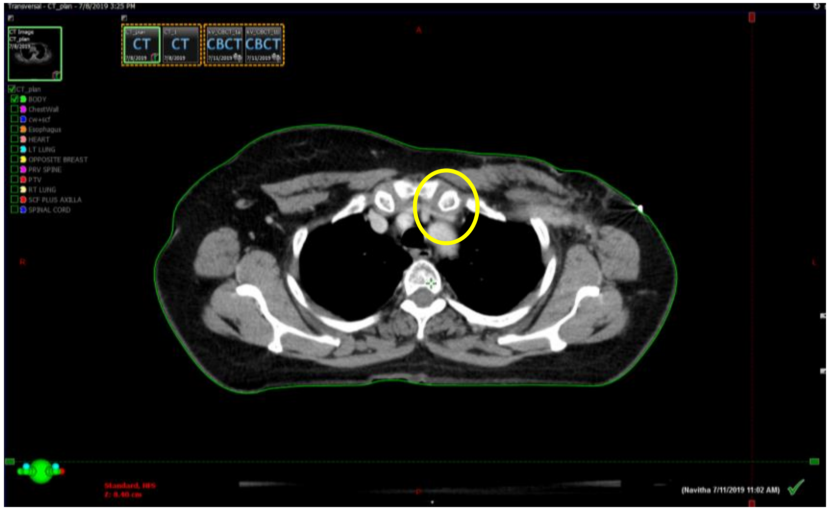
CT
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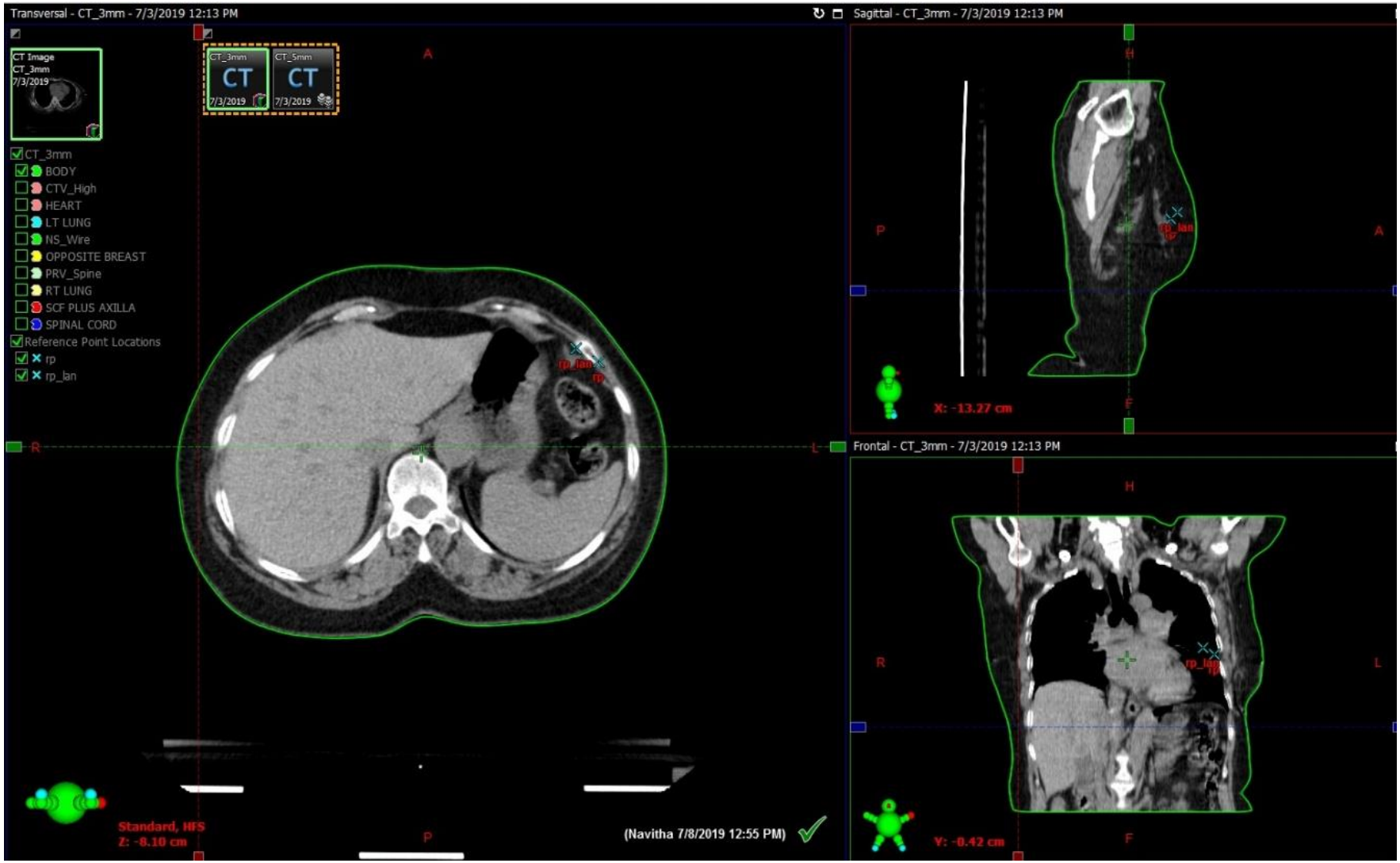
CBCT
CBCT

Caudal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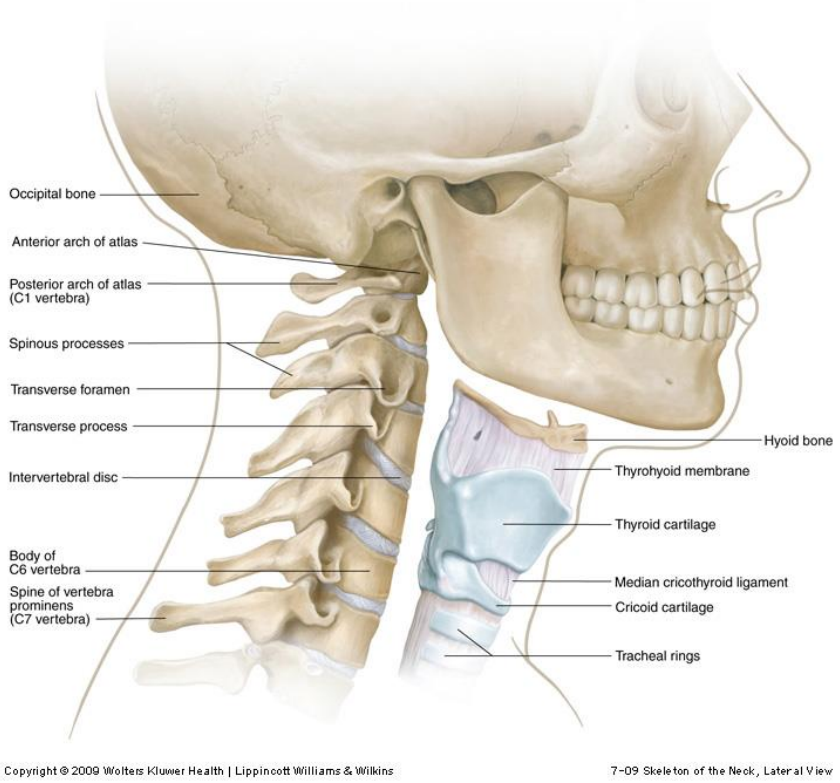
Frontal - CT_3mm - 7/3/2019 12:13 PM
CT Image
CT_3mm
7/3/2019
CT_3mm
CT
7/3/2019
CT_5mm
CT
7/3/2019
CT_3mm
BODY
CTV_High
HEART
LT LUNG
NS_Wire
OPPOSITE BREAST
PRV_Spine
RT LUNG
SCF PLUS AXILLA
SPINAL CORD
Reference Point Locations
rp
rp_lan
X: -13.27 cm
Y: -0.42 cm
Standard, HFS
Z: -8.10 cm
(Navitha 7/8/2019 12:55 PM)

Anterior, Posterior, Medial & Lateral

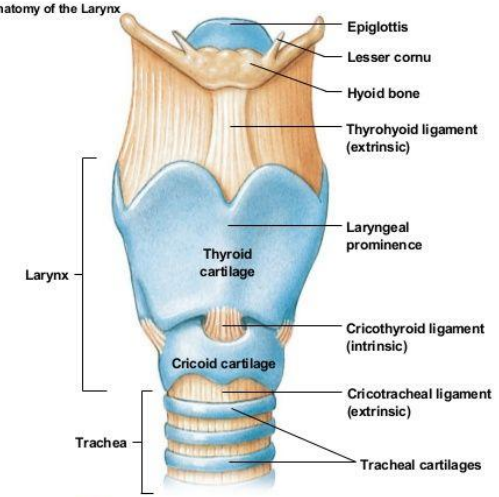
SECTION-A
CONTOURING, TARGET VOLUME DELINEATION

Chapter 4: Supraclavicular LNs

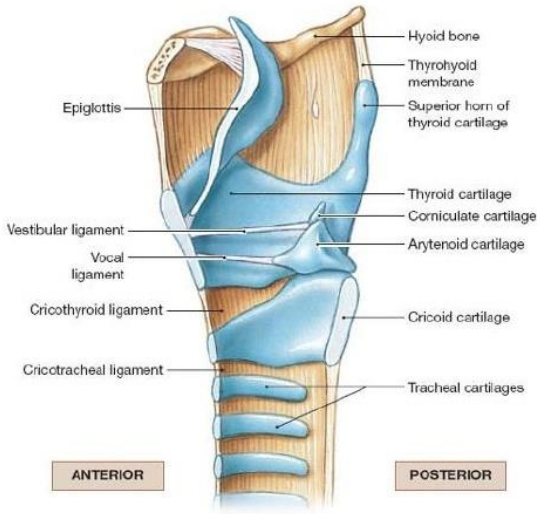


7-09 Skeleton of the Neck, Lateral View

Figure 24.6a Anatomy of the Larynx

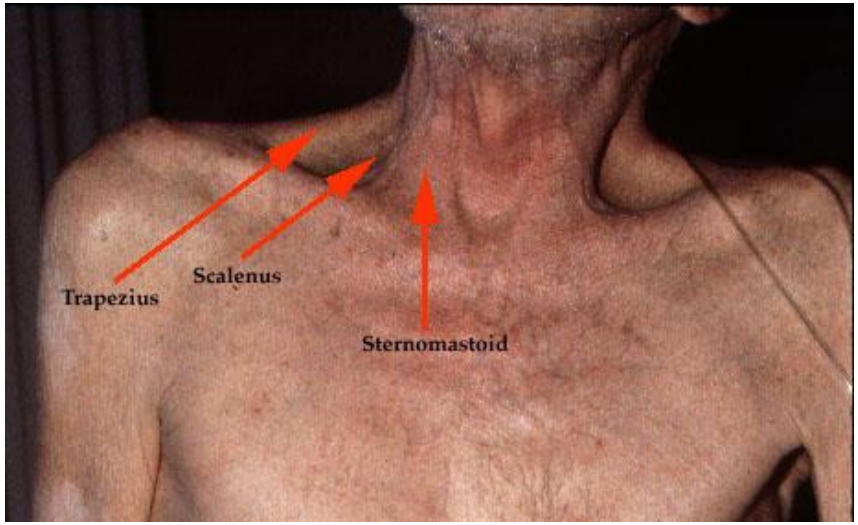


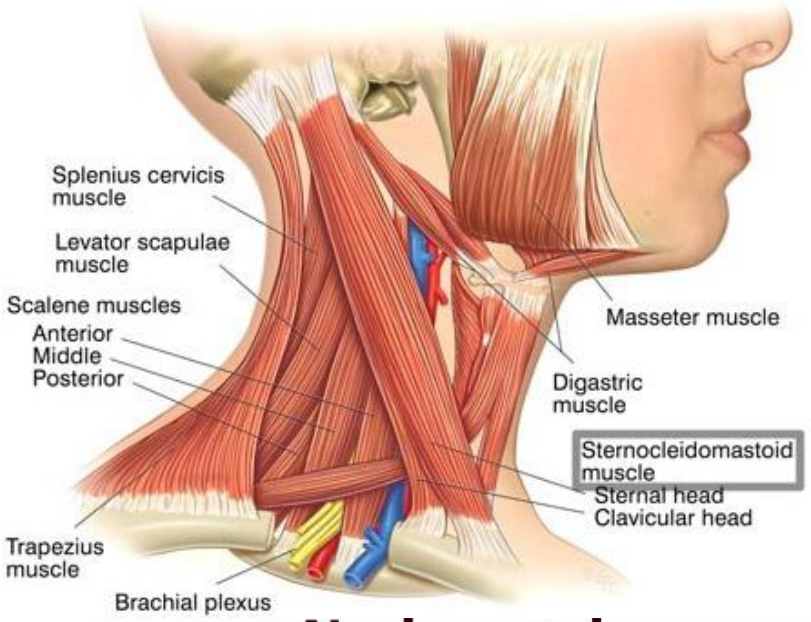
a Anterior view of the intact larynx

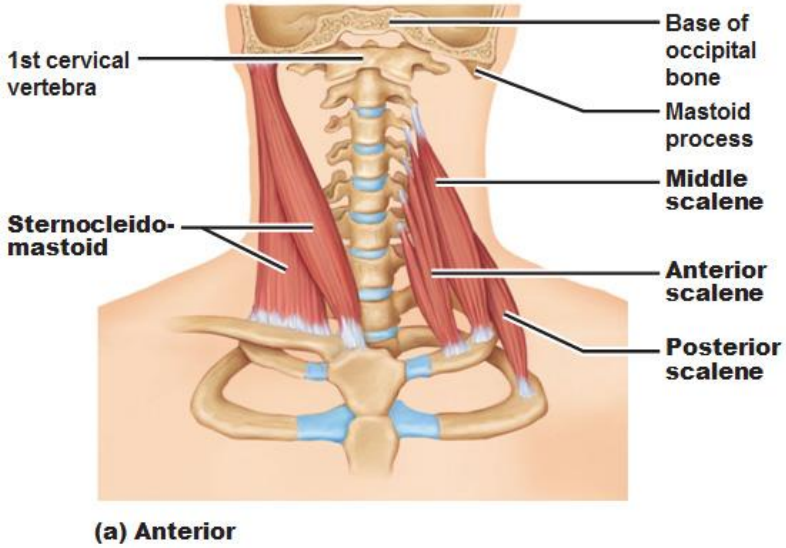


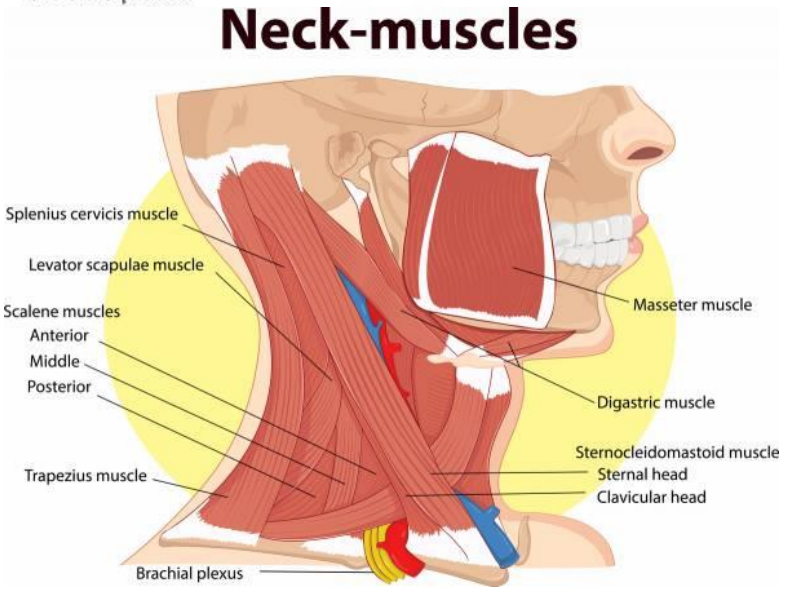
(d) Larynx, sagittal section

- Step 1: Recall the anatomy (Surface, 3 Dimensional and Radiological)







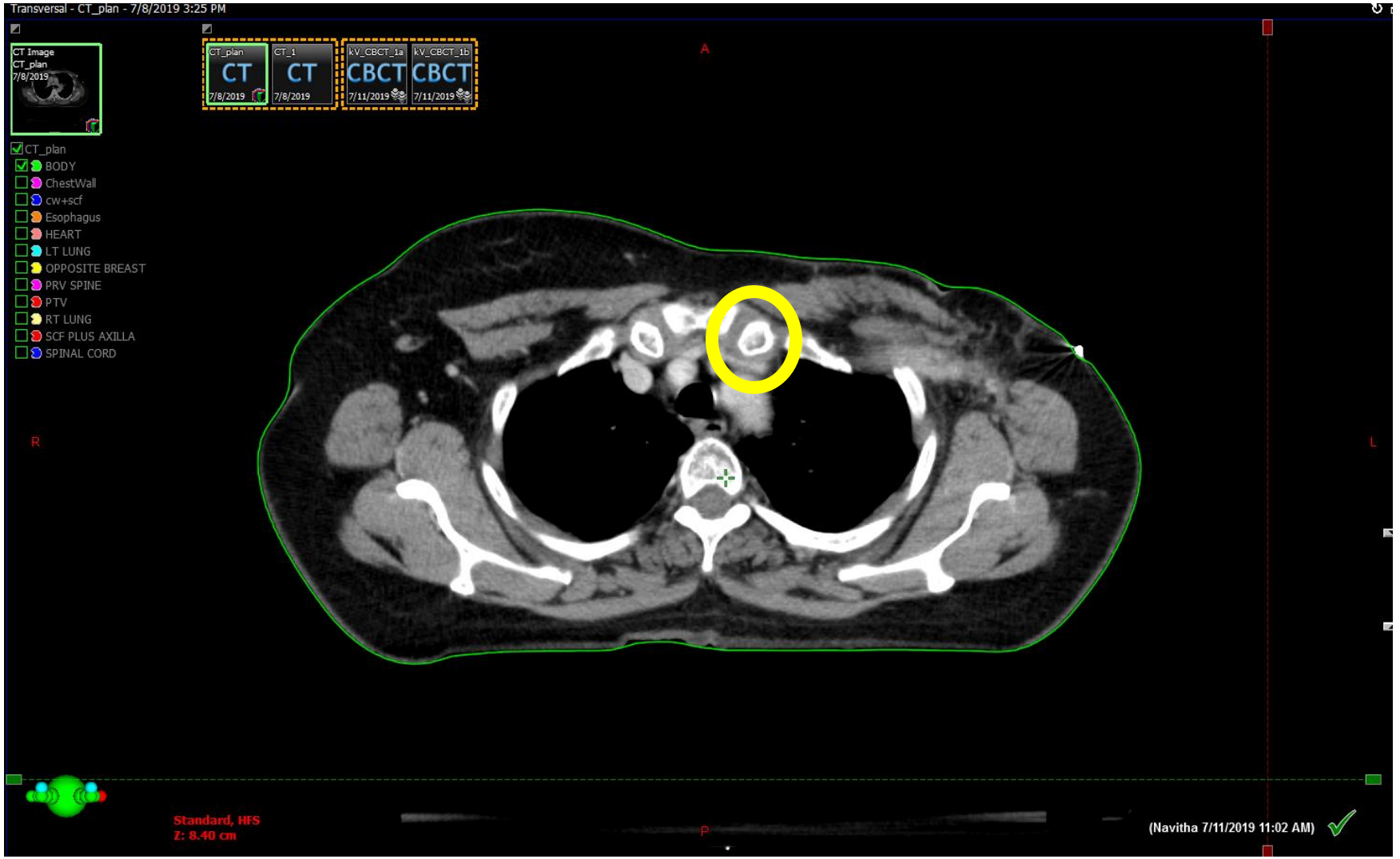


- Step 1: Recall the anatomy (Surface, 3 Dimensional and Radiological)

Cranial


Transversal - CT_plan - 7/8/2019 3:25 PM
Sagittal - CT_plan - 7/8/2019 3:25 PM
Frontal - CT_plan - 7/8/2019 3:25 PM
CT Image
CT_plan
7/8/2019
CT_plan
CT
7/8/2019
CT_1
CT
7/8/2019
kV_CBCT_1a
CBCT
7/11/2019
kV_CBCT_1b
CBCT
7/11/2019
CT_plan
BODY
ChestWall
cw+scf
Esophagus
HEART
LT LUNG
OPPOSITE BREAST
PRV SPINE
PTV
RT LUNG
SCF PLUS AXILLA
SPINAL CORD
R
L
H
F
X: -1.07 cm
Y: -1.07 cm
Standard, HFS
Z: 15.60 cm
(Navitha 7/11/2019 11:02 AM)

Caudal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CT Image
CT_plan
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CT_plan
CT
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CT_1
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kV_CBCT_1a
CBCT
7/11/2019
kV_CBCT_1b
CBCT
7/11/2019
CT_plan
BODY
ChestWall
cw+scf
Esophagus
HEART
LT LUNG
OPPOSITE BREAST
PRV SPINE
PTV
RT LUNG
SCF PLUS AXILLA
SPINAL CORD
A
R
L
P
Standard, HFS
Z: 8.40 cm
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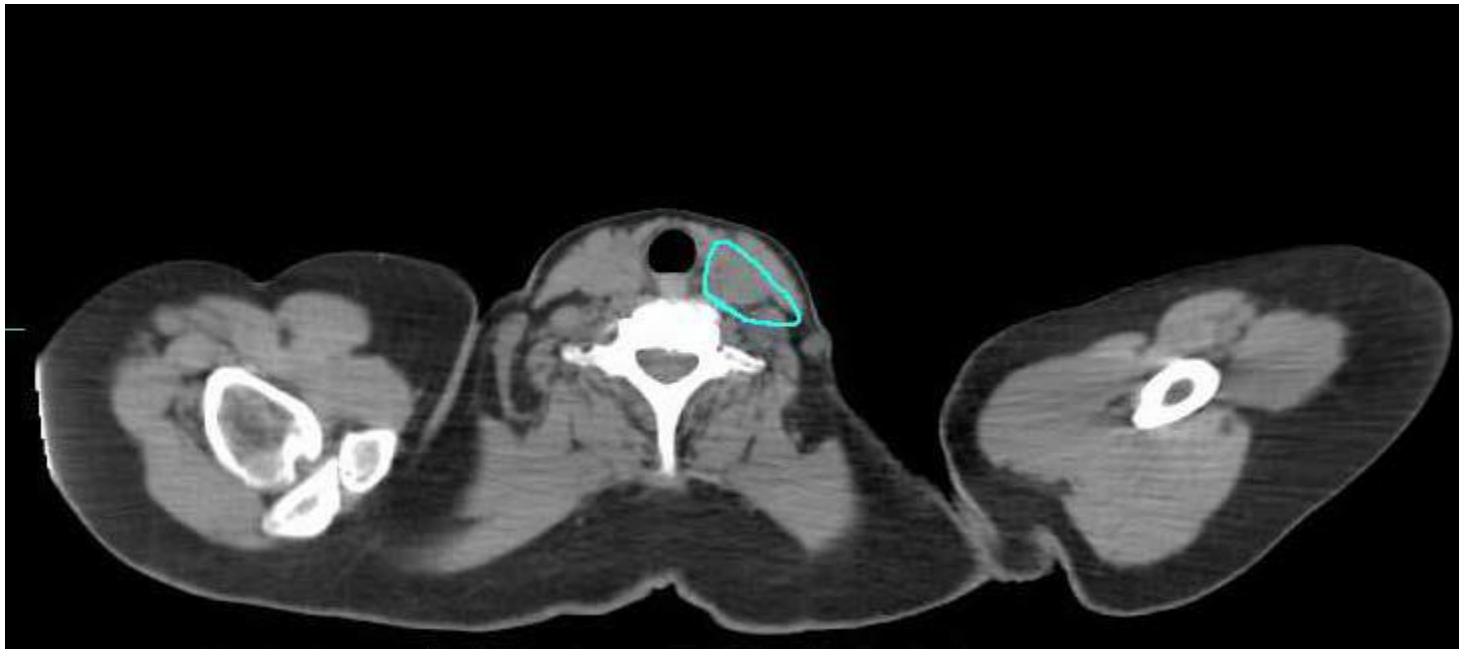
Anterior, Posterior, Medial & Lateral

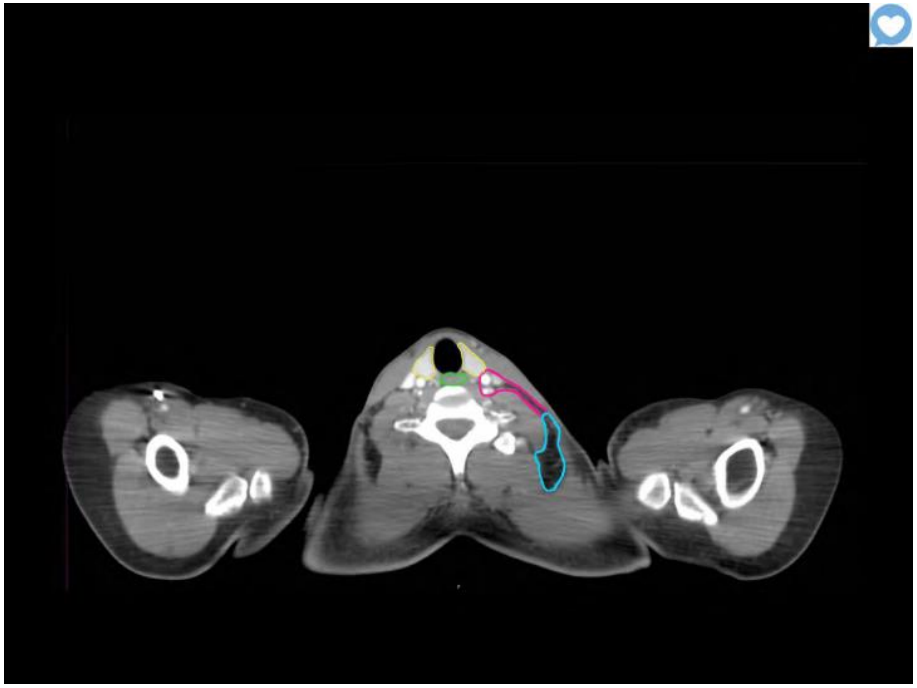


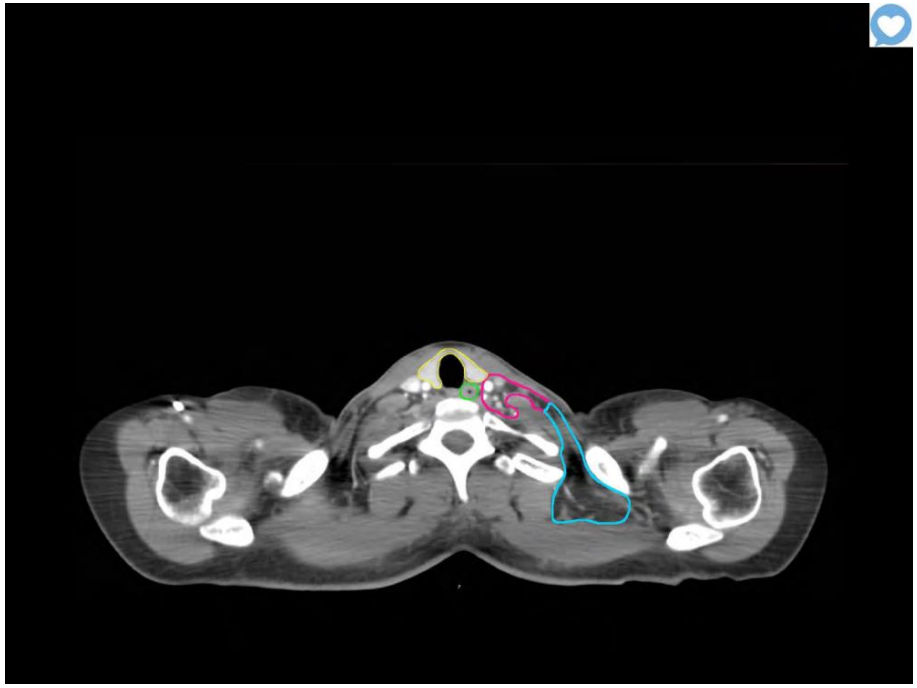
RadComp
PATIENT POWERED
A study at the heart of breast cancer treatment

Breast Contouring
RADCOMP Consortium

v.3

February 23, 2016

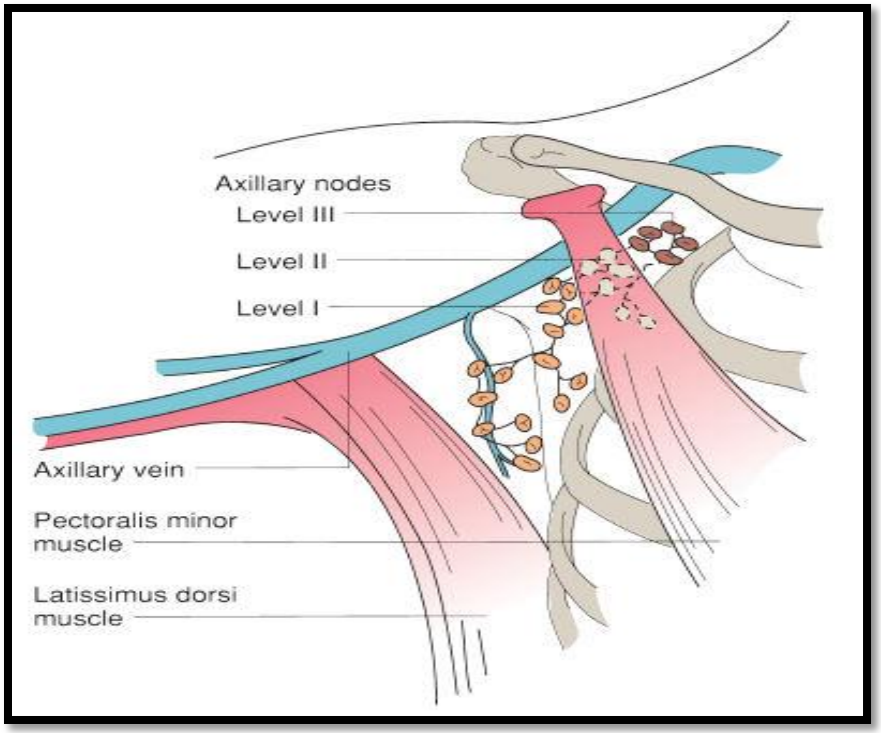


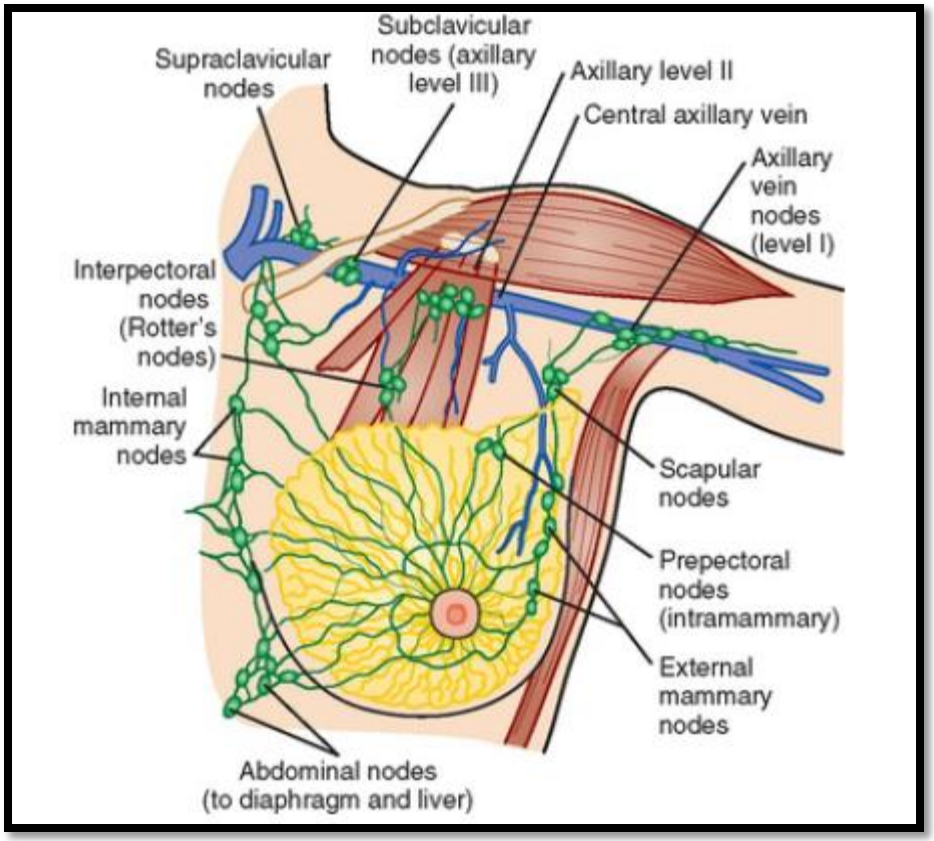


SECTION-A
CONTOURING, TARGET VOLUME DELINEATION

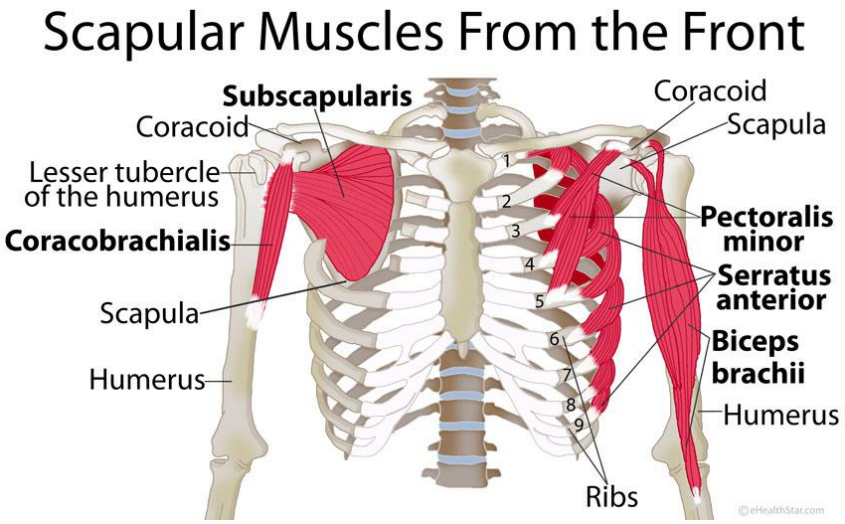
Chapter 5: Axillary Nodes

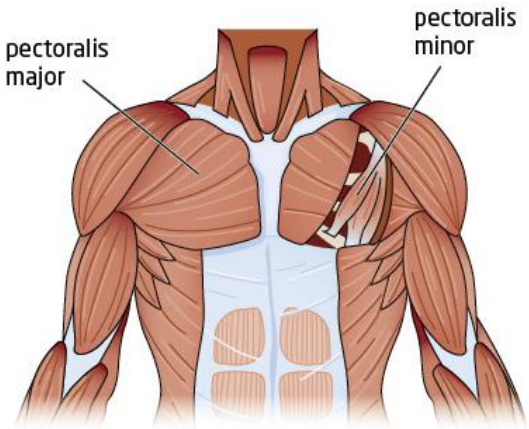
AXILLA ANATOMY

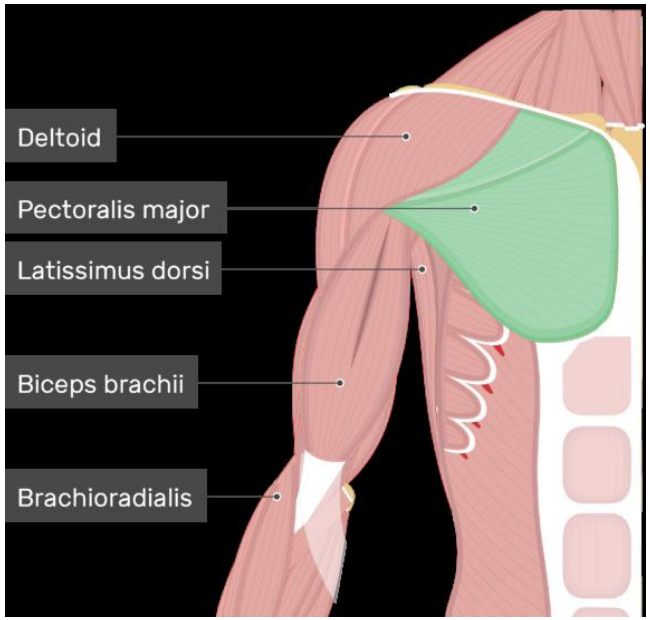


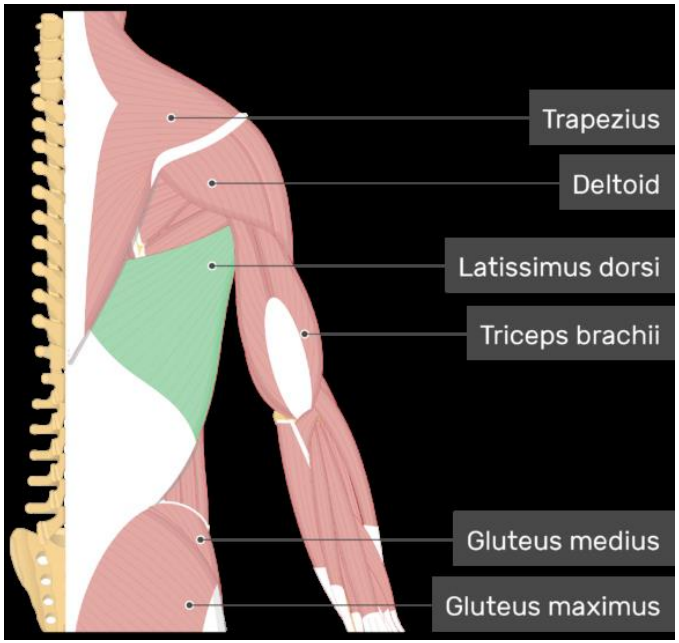


- Step 1: Recall the anatomy (Surface, 3 Dimensional and Radiological)



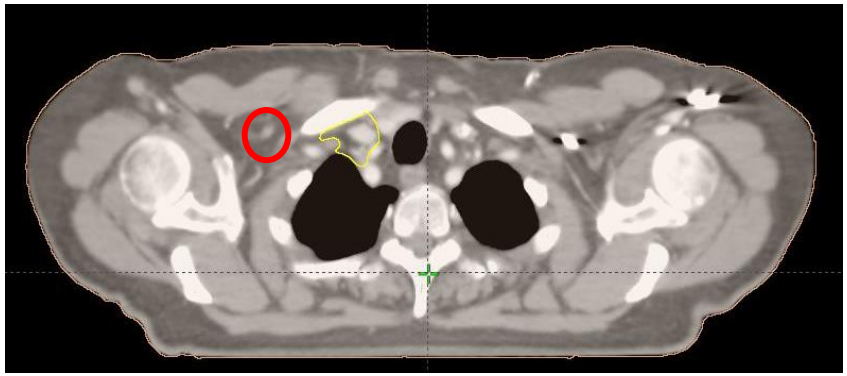


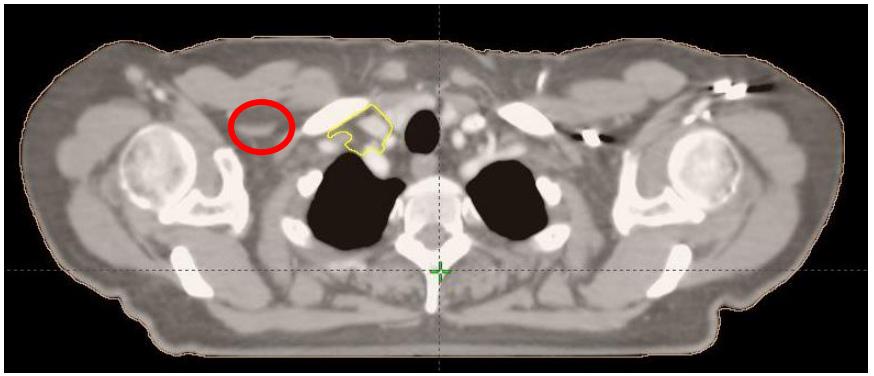


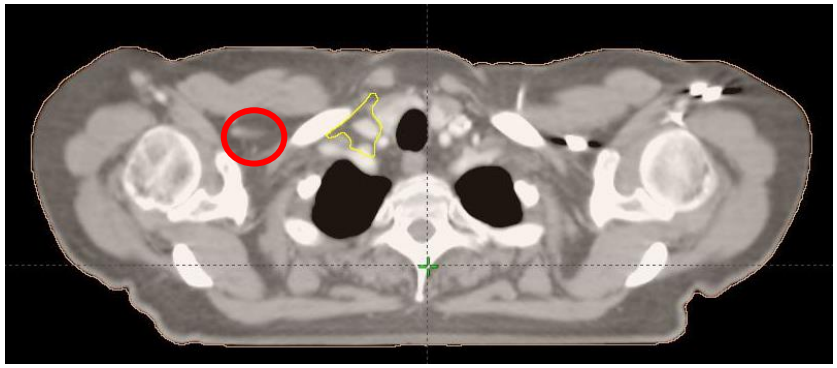


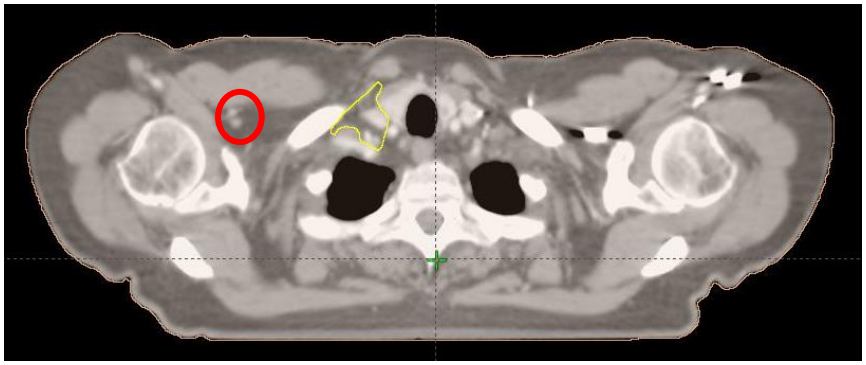
- Step 1: Recall the anatomy (Surface, 3 Dimensional and Radiological)

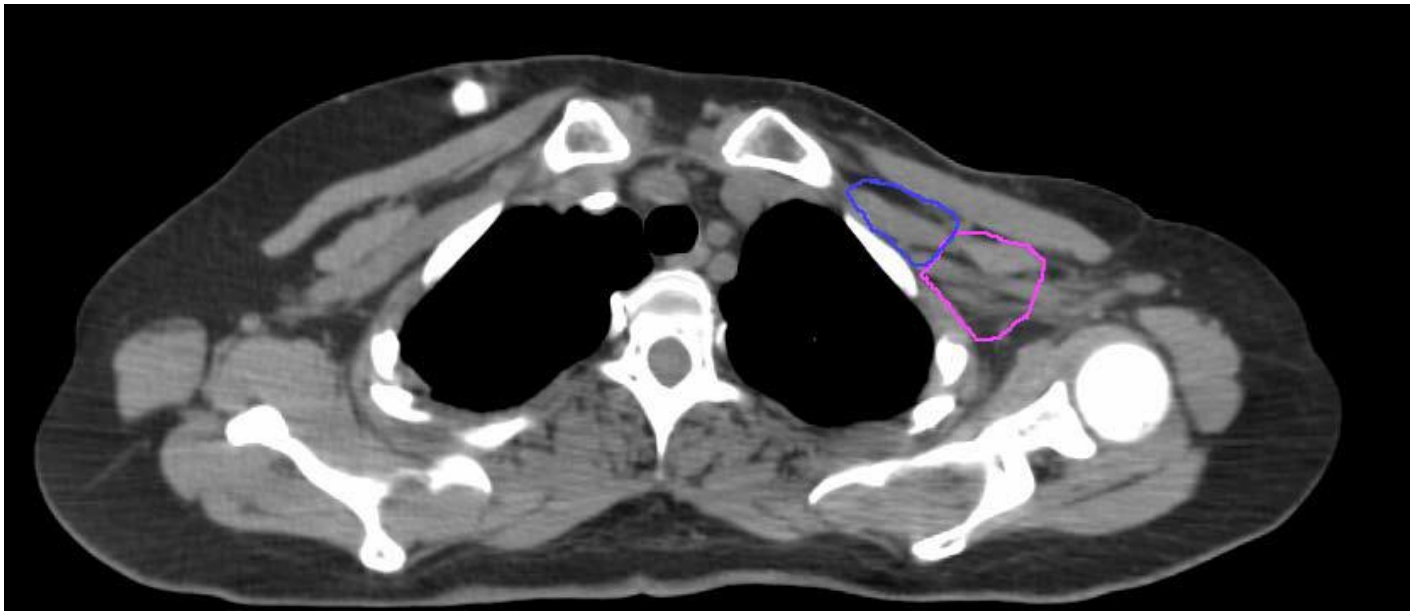
Axillary Vessel



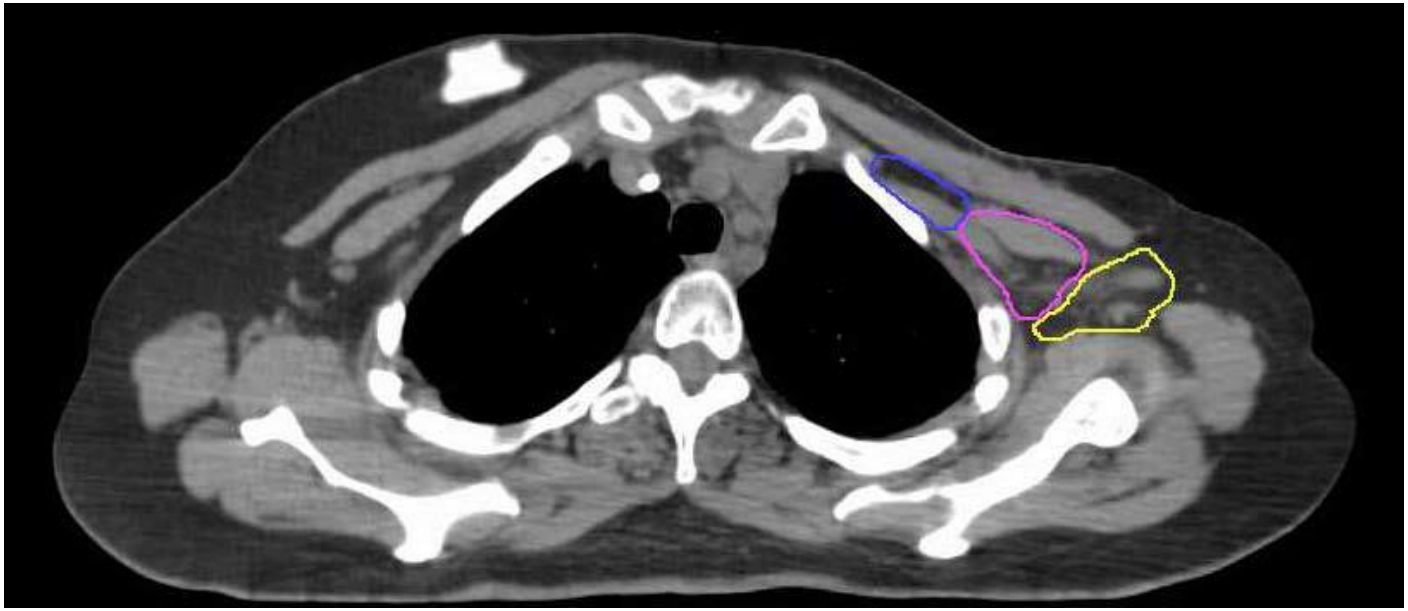








Level
II, III



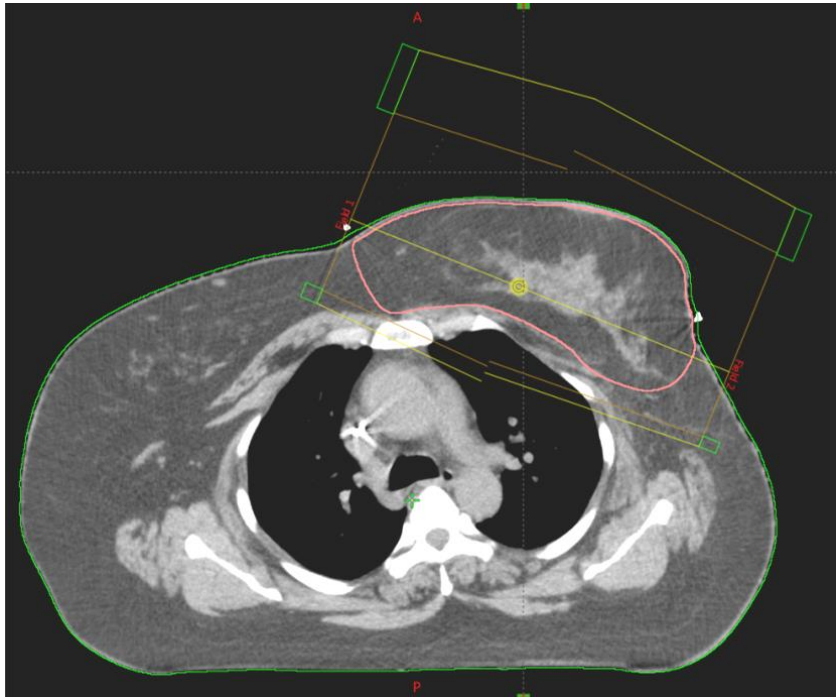
Level
I, II, III

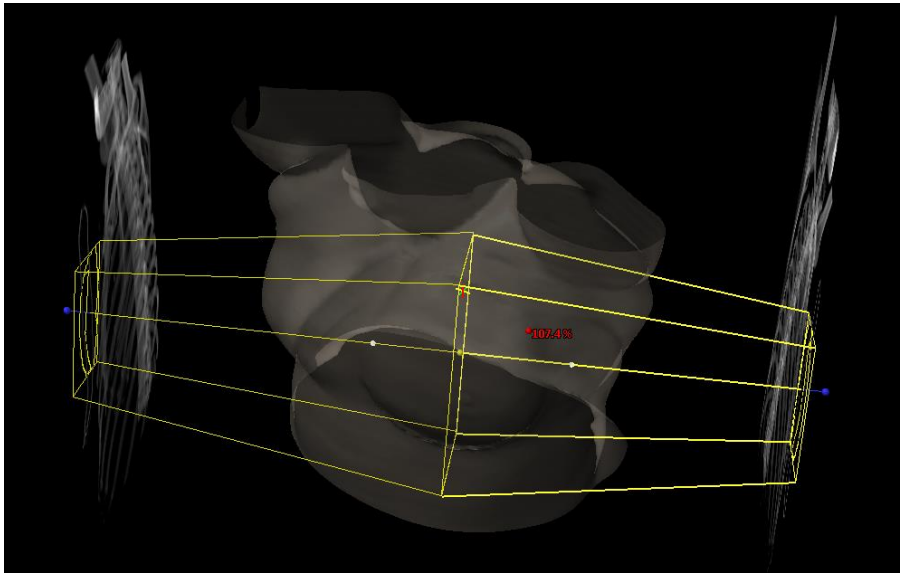
SECTION-B
3D CT BASED PLANNING OF BCT

Chapter 6:

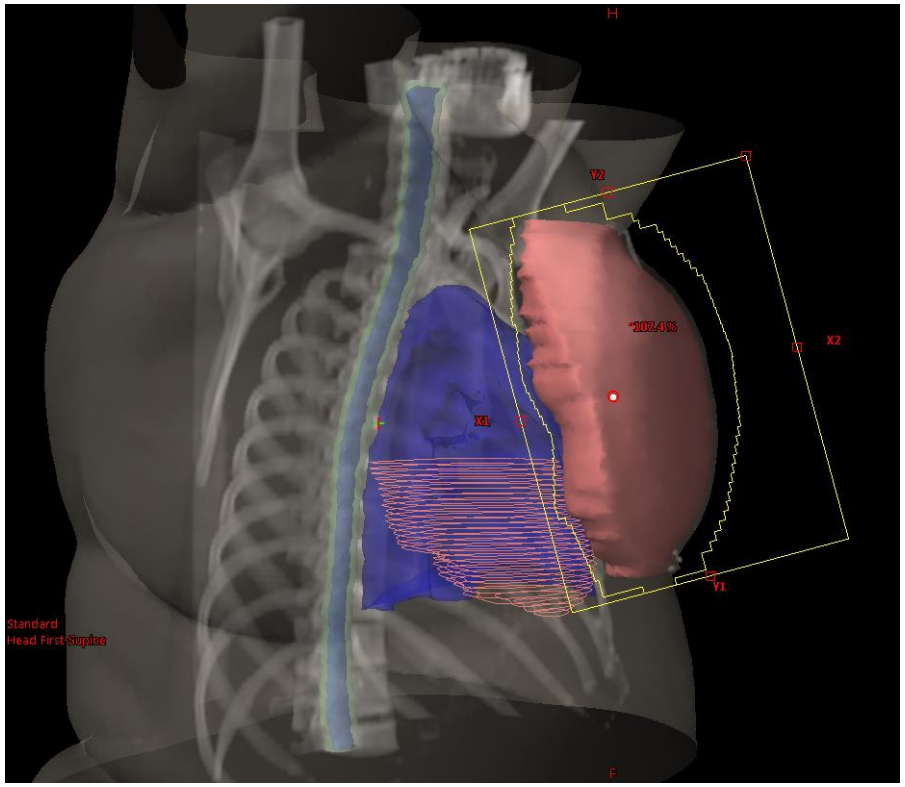
- Tangential fields
- Field in field
- Small Tangentials
- Mono isocentric for 3 fields

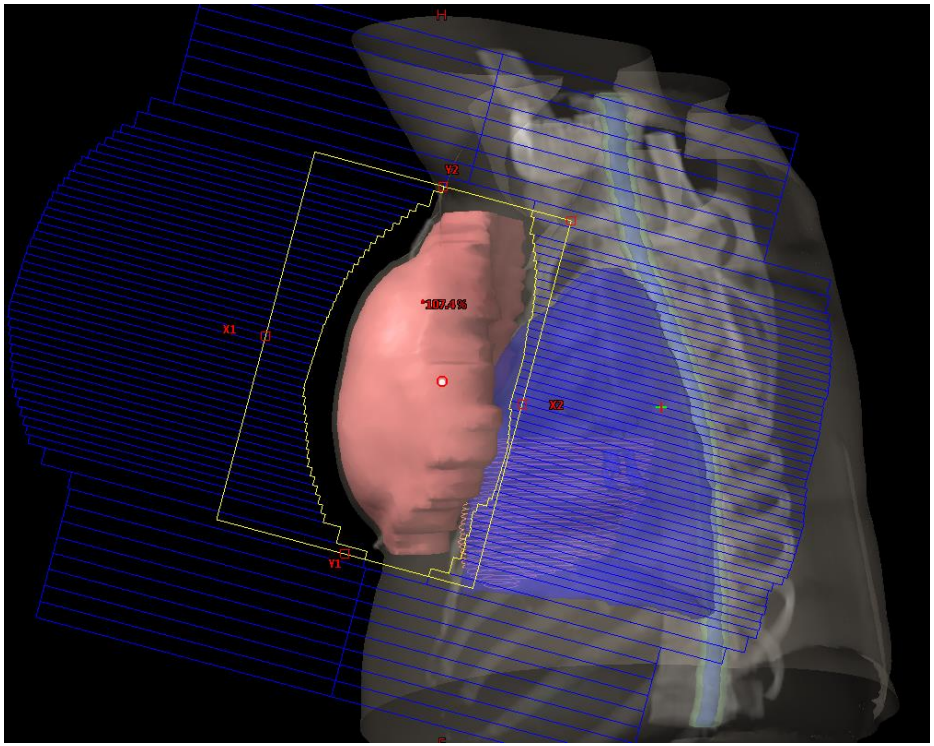
Tangentials



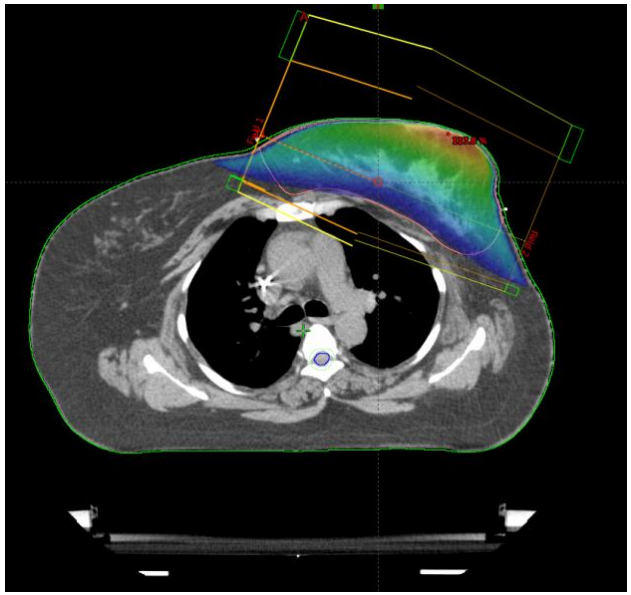


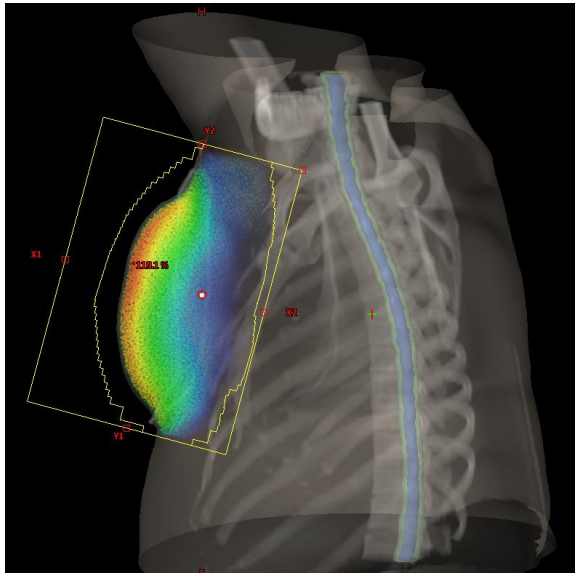
Beam's Eye View of Tangentials

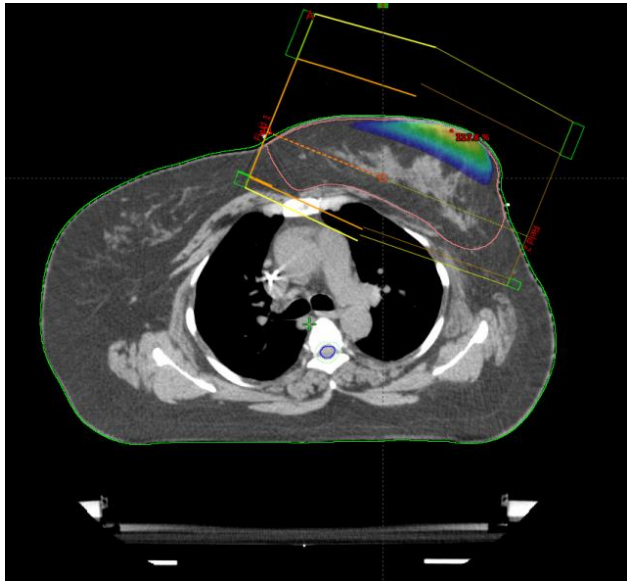


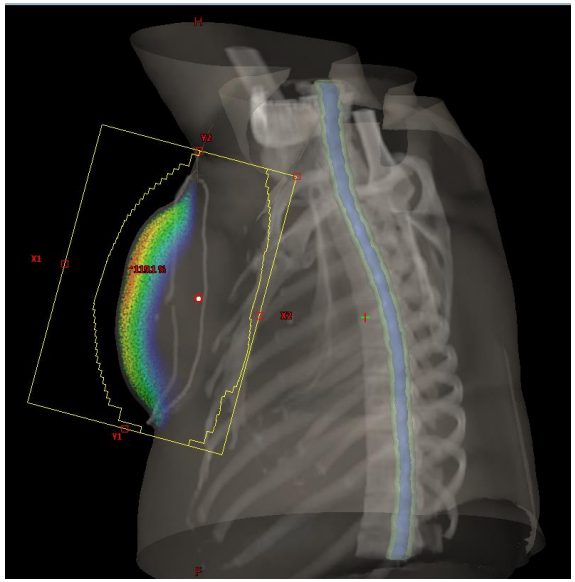


Dose wash reveals ‘hot spot’

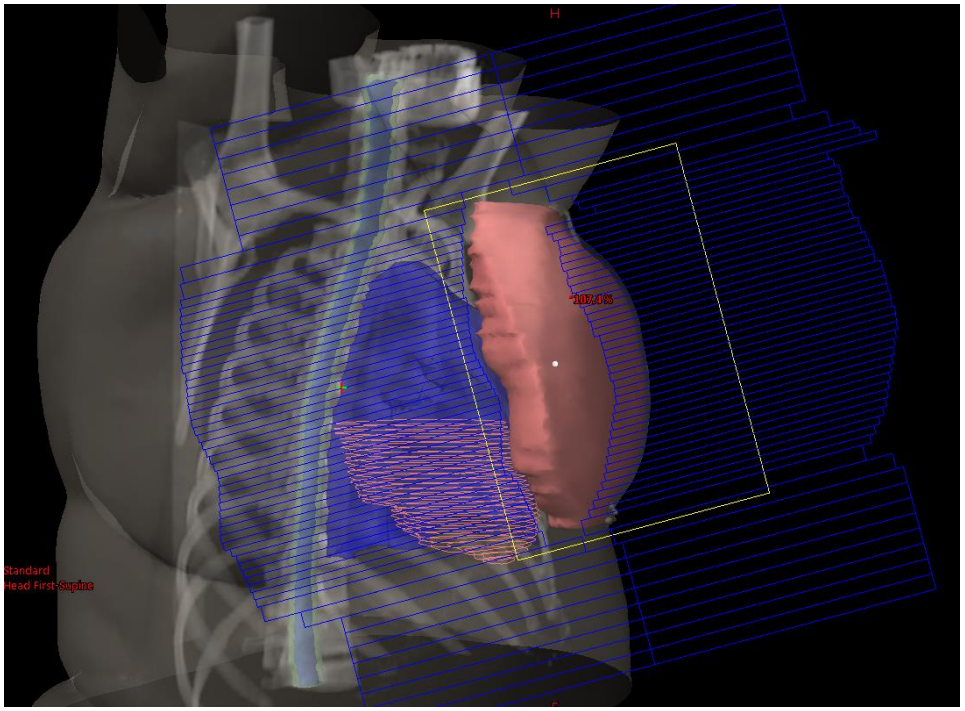


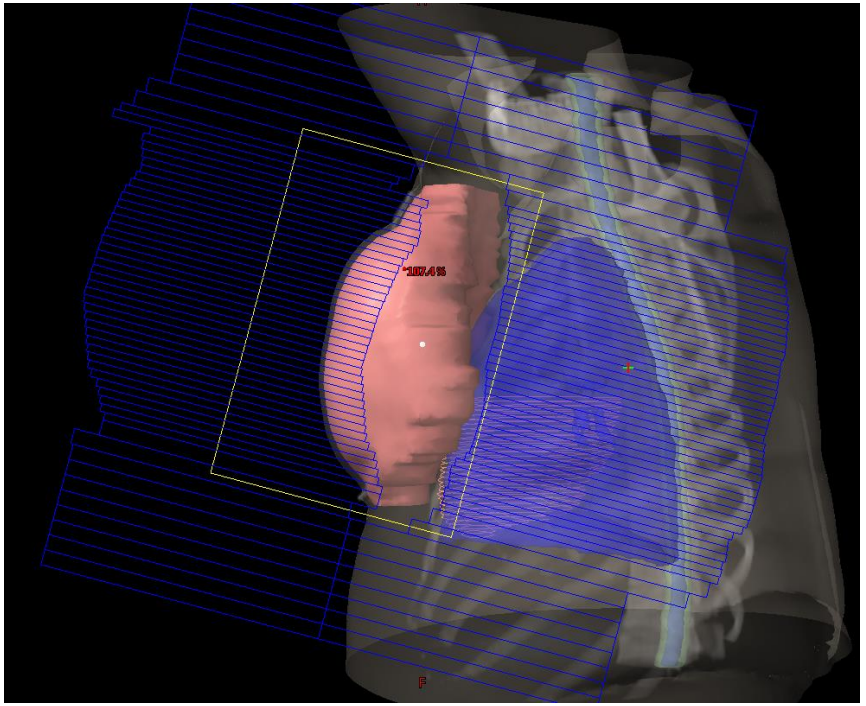




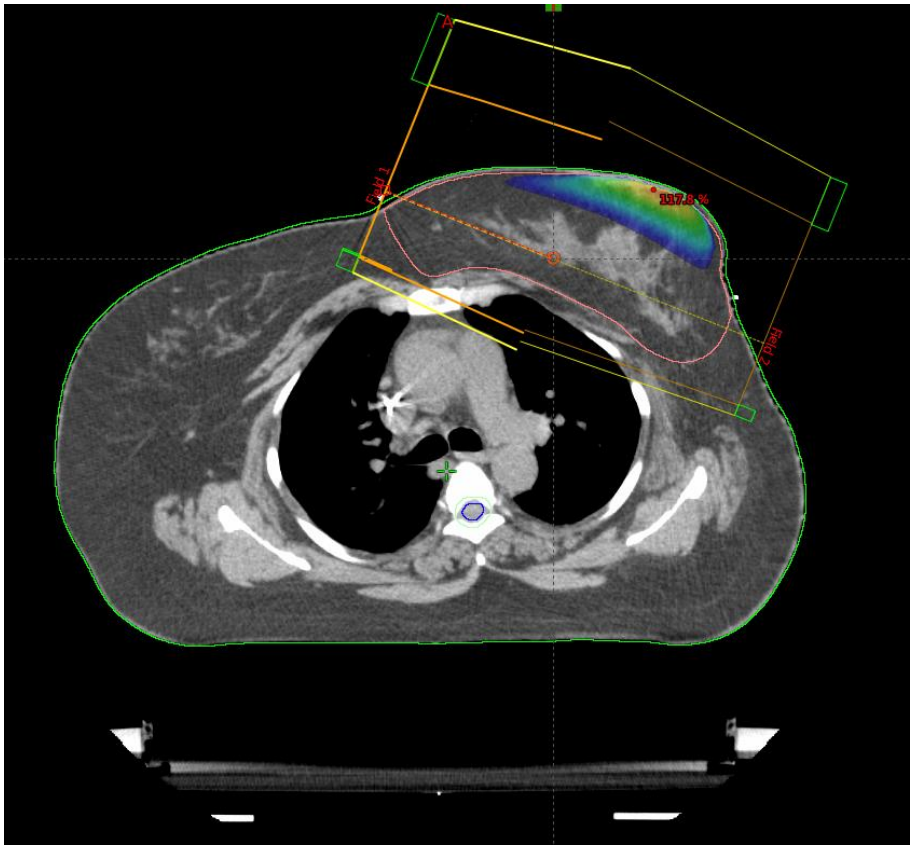


‘Field in Field’ Technique

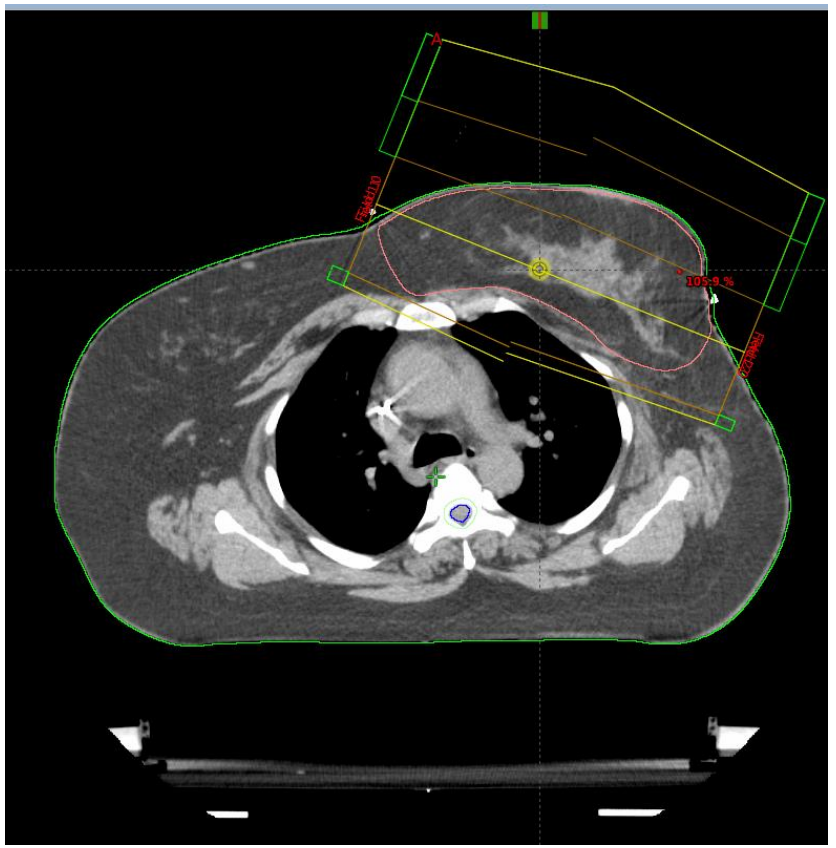




‘Hot spot’ tackled

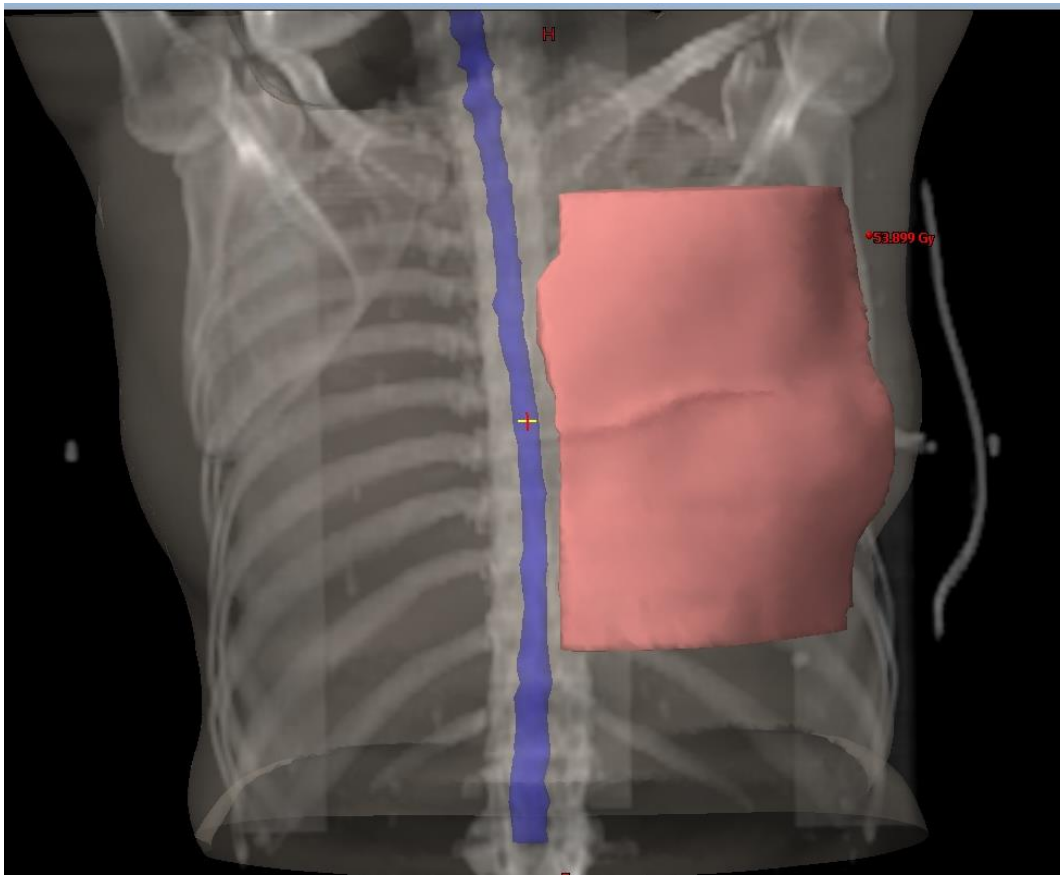


Before FIF



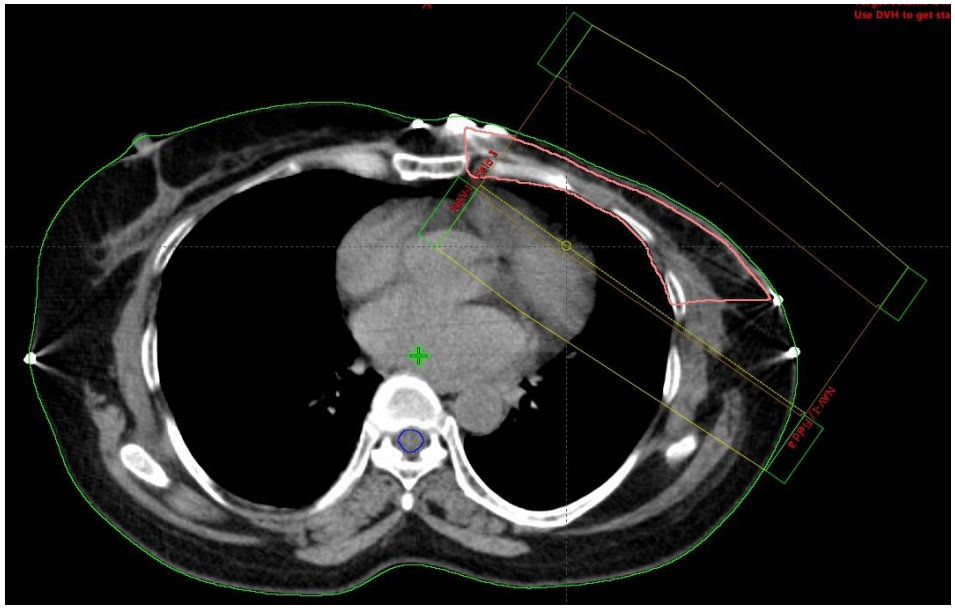
After FIF

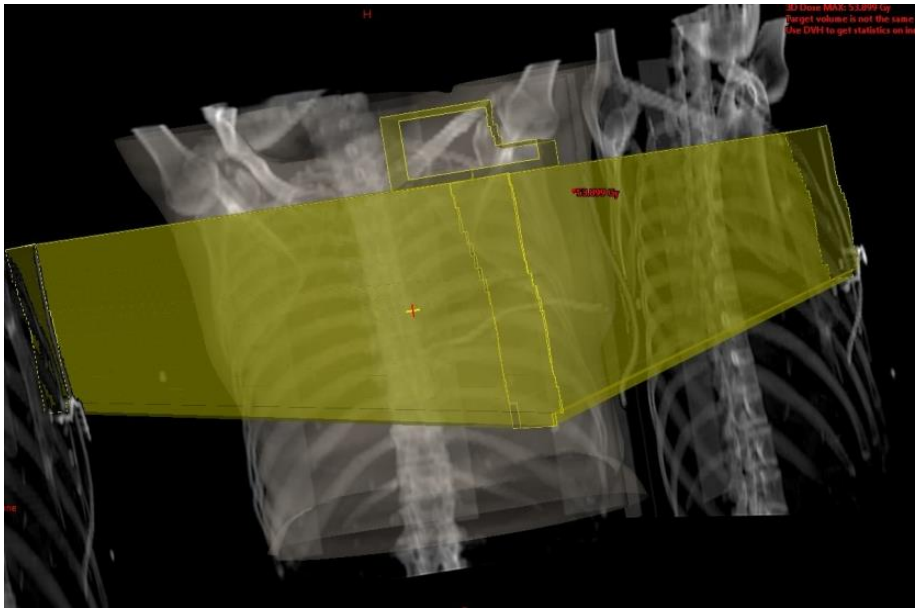
Quick revision of Chest wall RT in MRM



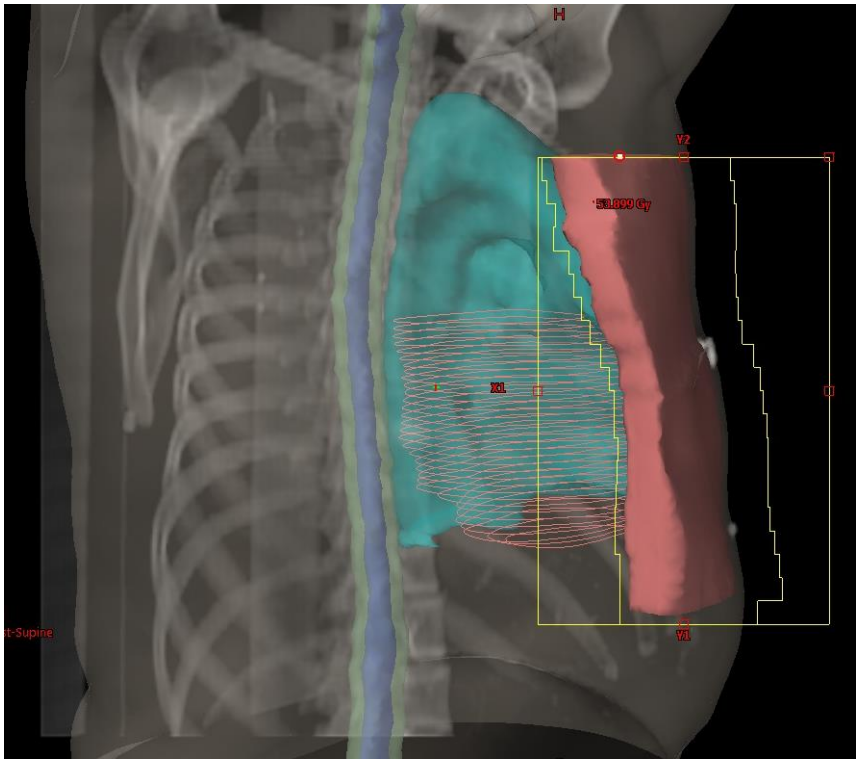
Re-enhancement of Radiotherapy planning concepts

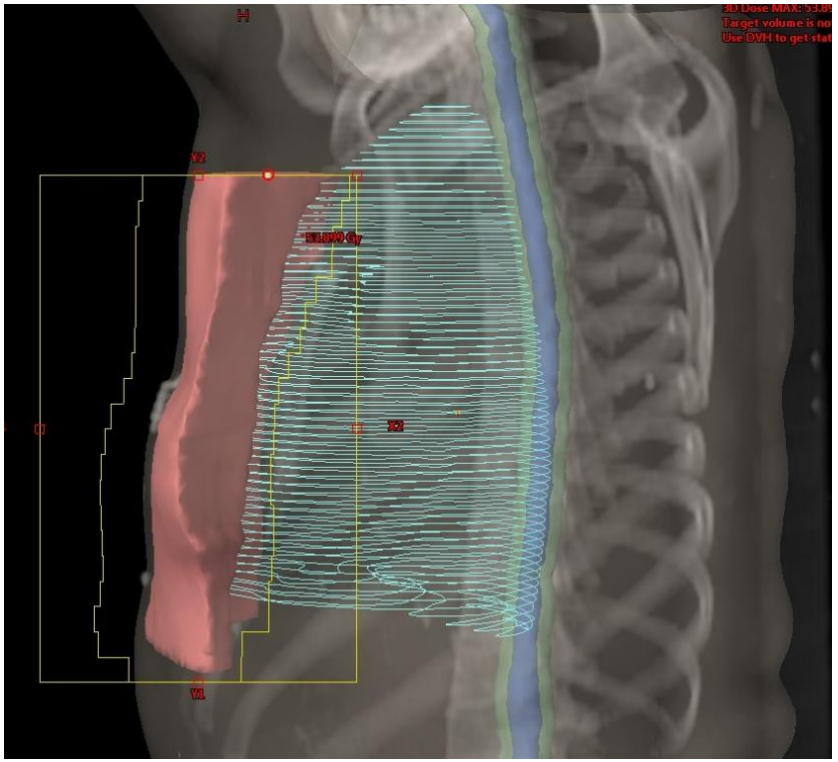
Tangentials



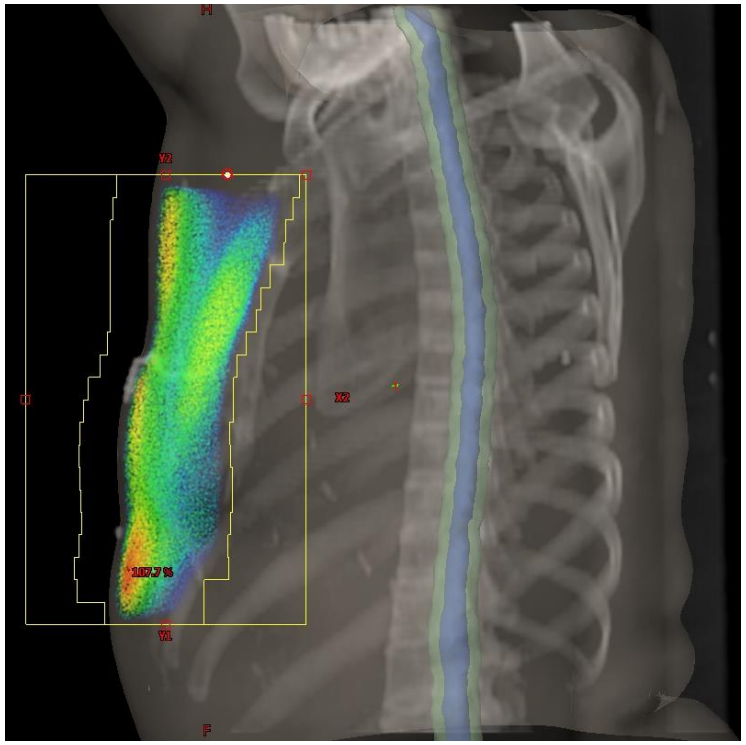


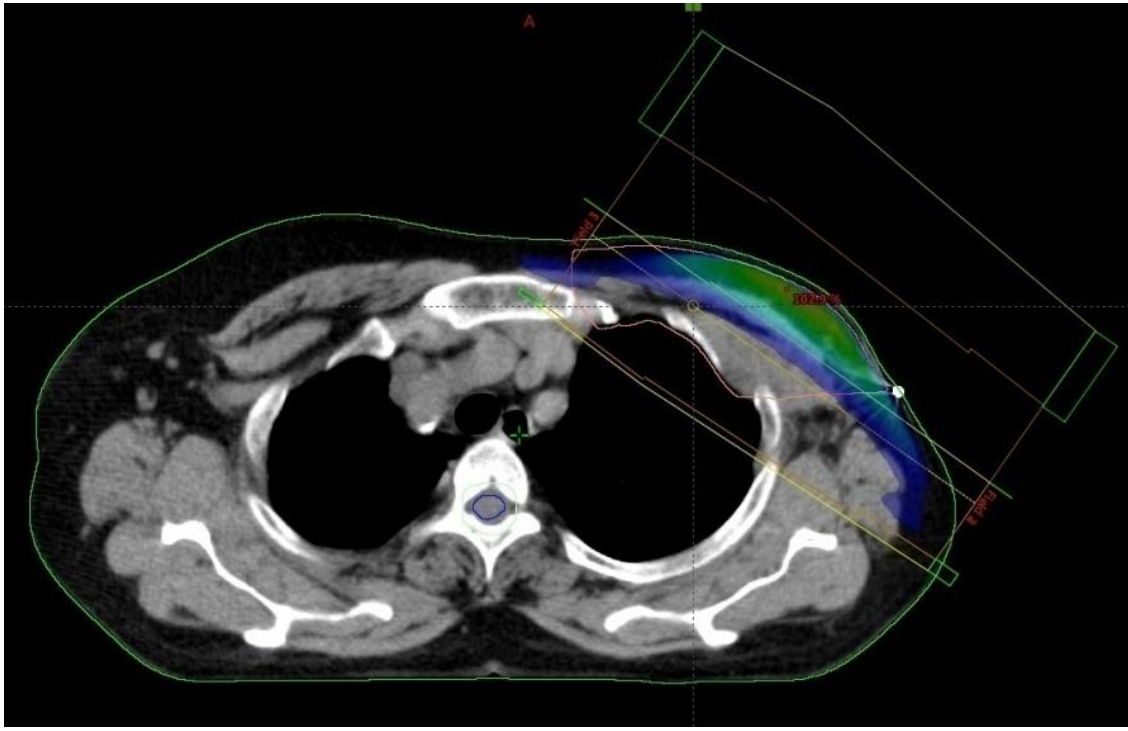
Beam's Eye View of Tangentials



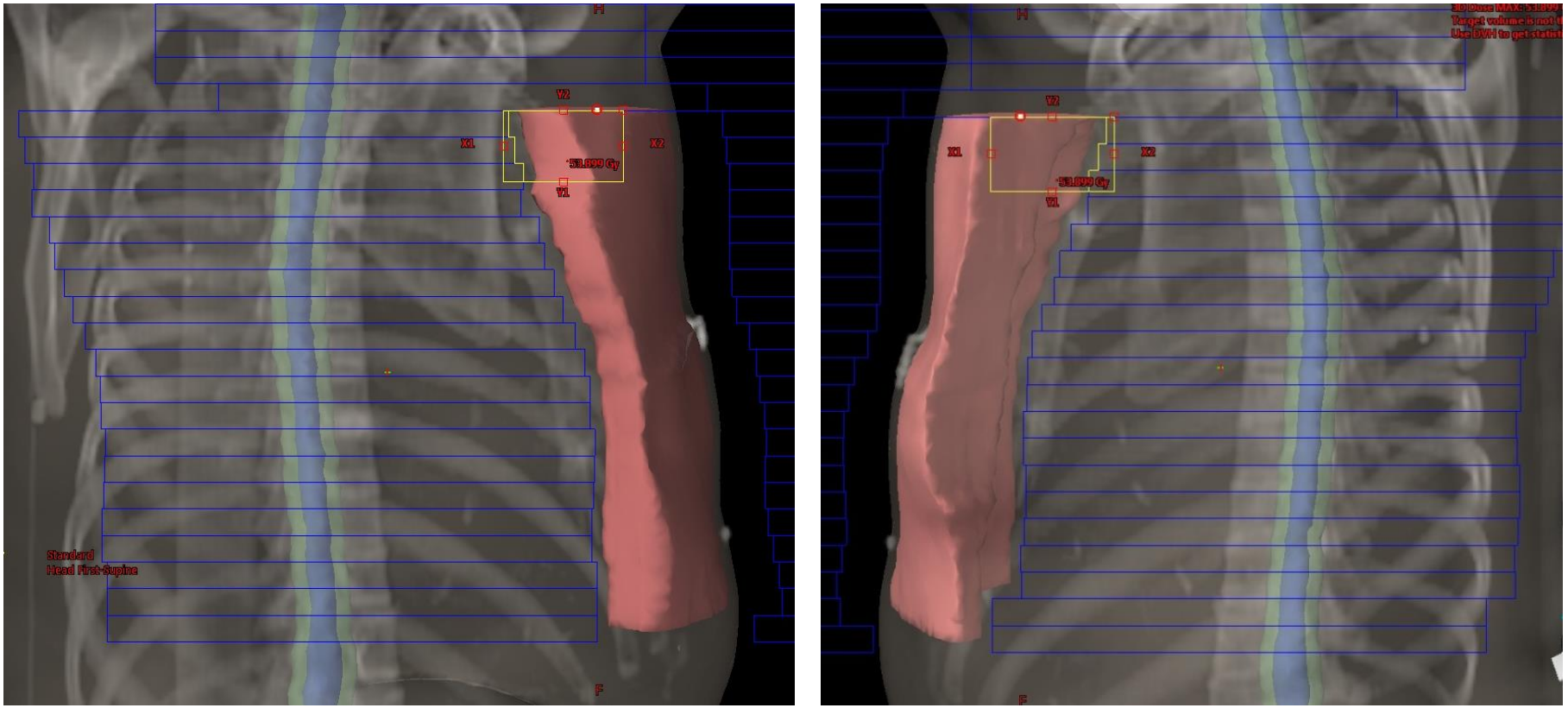


Dose wash reveals ‘cold spot’

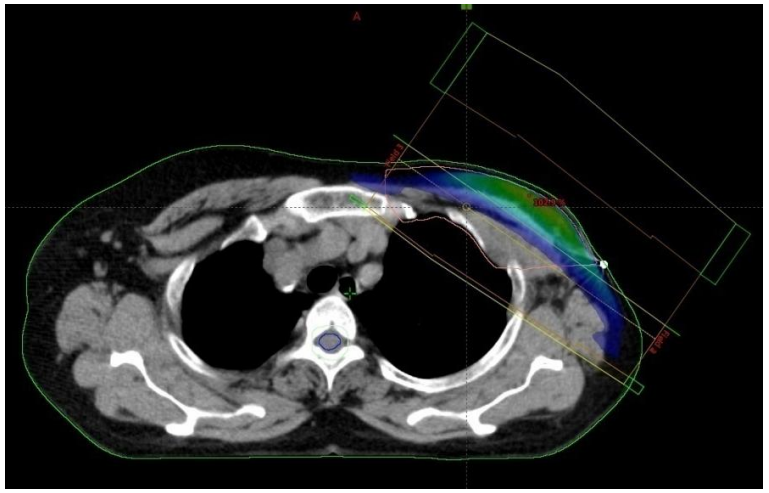


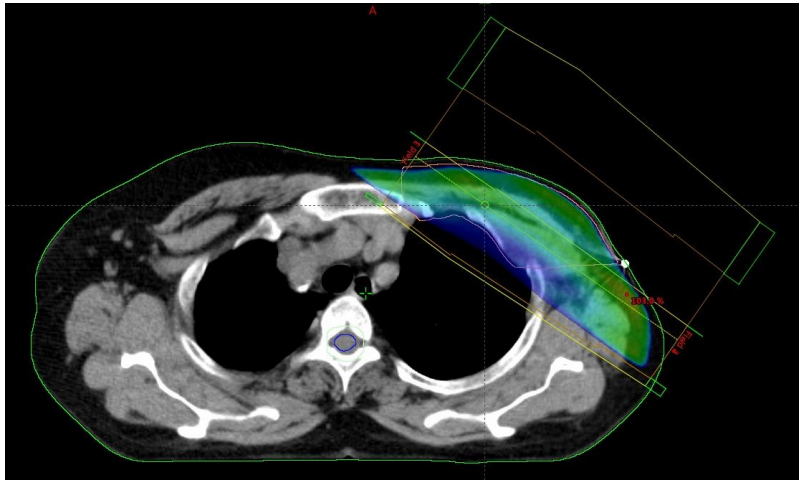


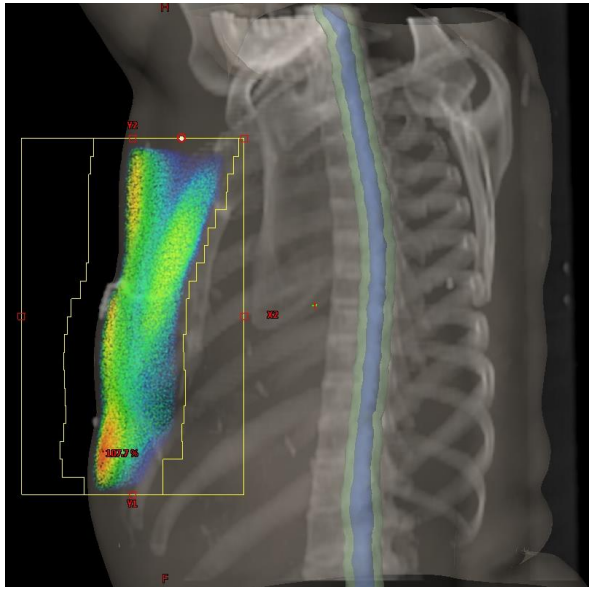
Additional ‘small tangential’ fields

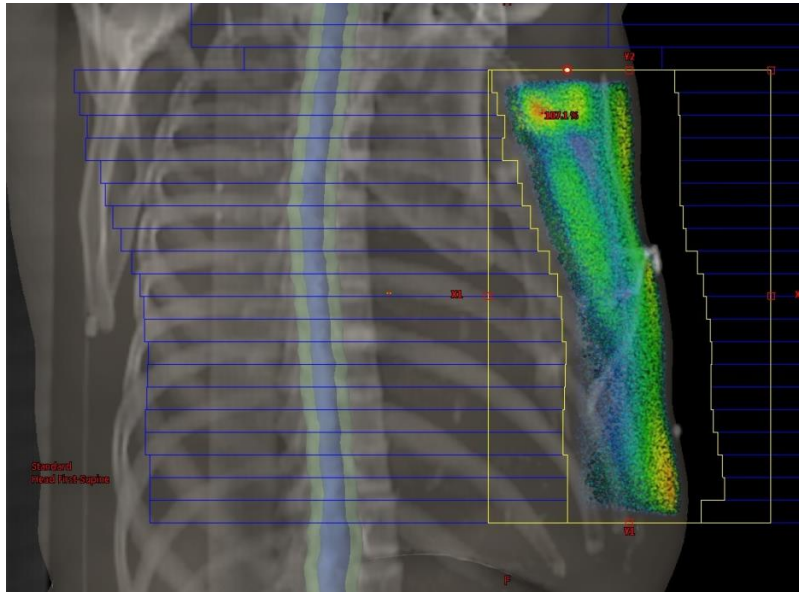


‘Cold spot’ tackled





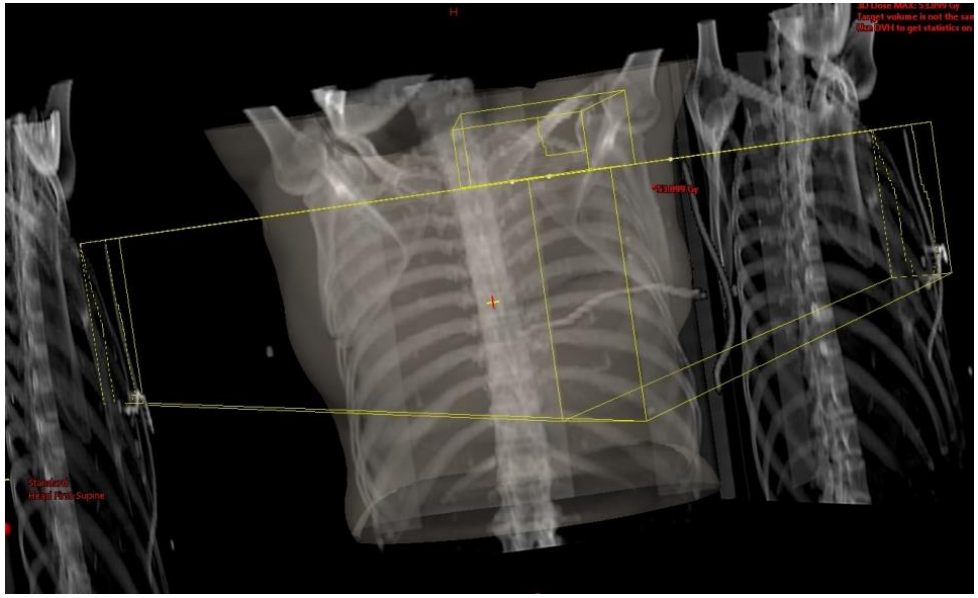


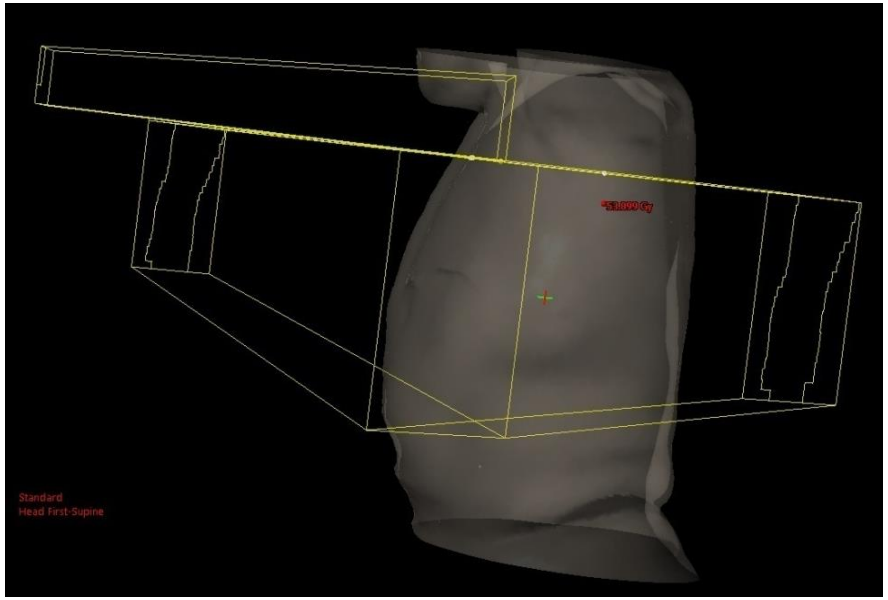


Before adding small tangential

After adding small tangential

Mono Isocentric Technique for 3 fields





SECTION-C
PLAN EVALUATION

Chapter 7:

- Prescription
- Dose to OARs
- DVH

Prescription

TABLE 59.26 TREATMENT POLICY FOR CONSERVATIVE MANAGEMENT OF EARLY-STAGE INVASIVE BREAST CANCER

Treatment Volume	Indication	Fraction Size/Technique	Total Dose	Comment
Whole breast	Routinely following BCS	2 (prefer) or 1.8 Gy/ tangents with wedges or dynamic wedges to optimize homogeneity	45—50.4 Gy	Consider omission of RT in elderly with stage I disease and comorbidities
Boost	Routinely following whole breast	2 or 1.8 Gy (prefer 2 Gy)/*en face* electrons	10—16 Gy to bring total dose to >60 Gy	Consider no boost for widely negative margins in women over 60
Accelerated whole	On protocol or ASTRO	2.66 Gy tangents with no nodal fields/no boost	42.5 Gy	

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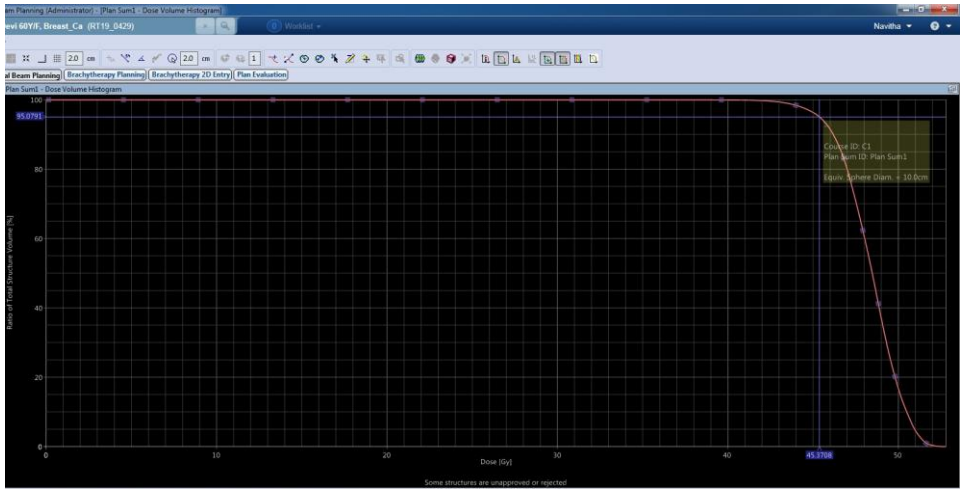
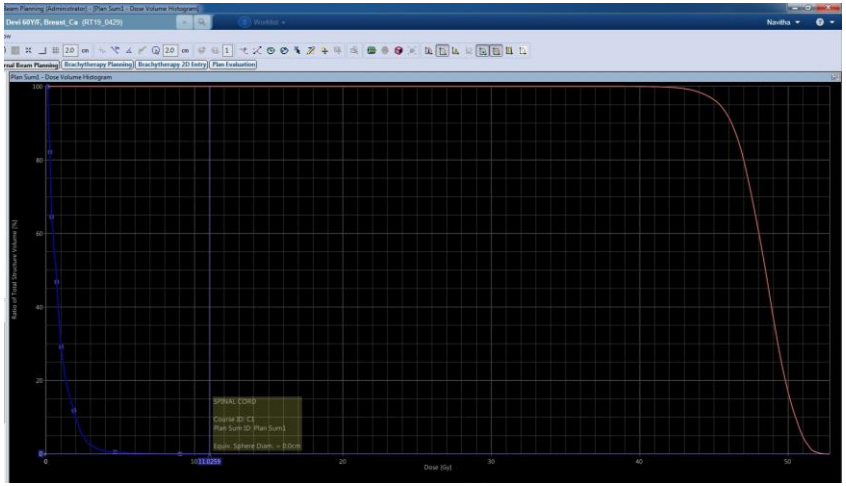
Constraints for organs at risk

Organ	Dose/volume parameters	Guidelines	1/3 VOLUME	2/3 VOLUME	3/3 VOLUME
Spinal Cord PRV	Dmax =50	QUANTEC	50	50	47
Lung	V20≤30%	QUANTEC	45	30	17.5
	Mean Dose=13				
	V20<20%	RTOG			
	Dmean<20				
Heart	Mean Dose <26	QUANTEC	60	45	40
	V30<46%				
	V50<33%	RTOG			
	V45<67%				
Esophagus	Mean Dose <34	QUANTEC	60	58	55
	V35<50%				
	V50<40%				

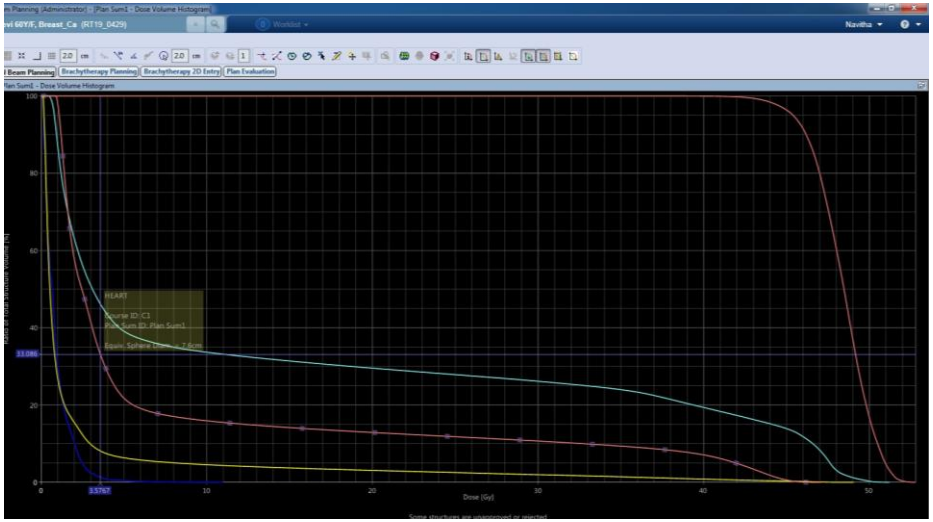
Dose Volume Histograms



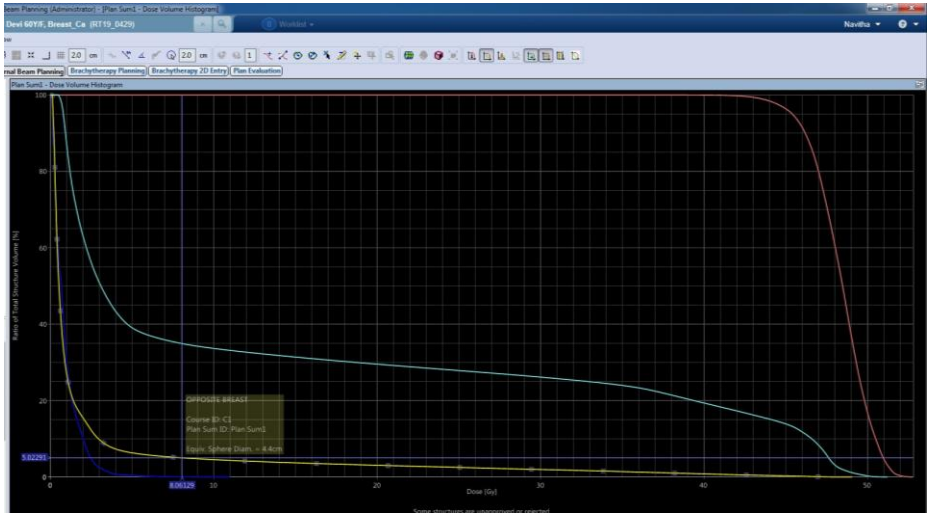
PTV



Spinal Cord

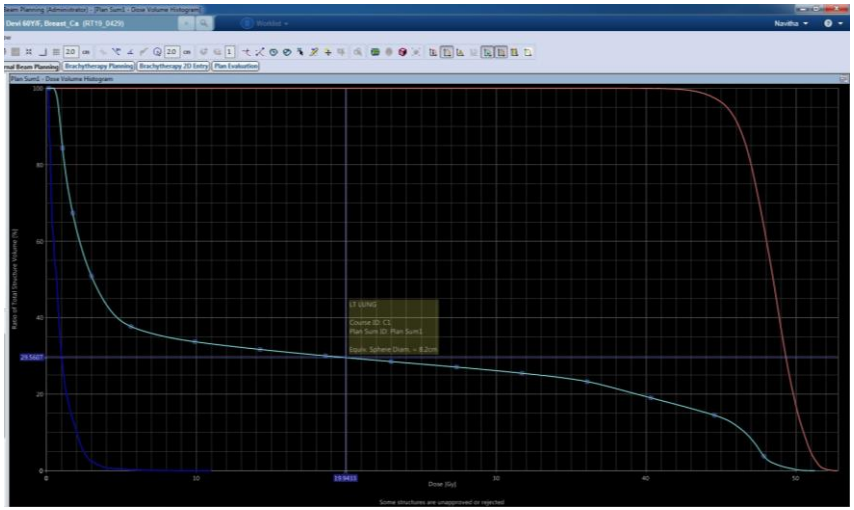


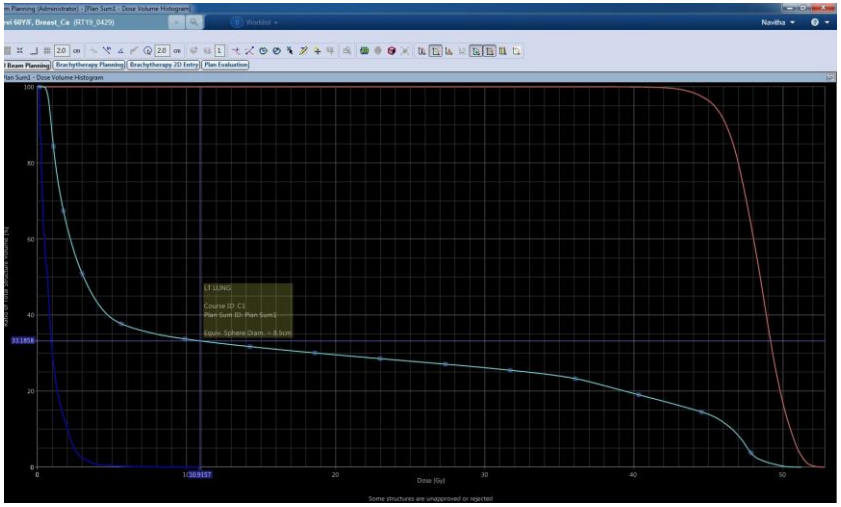
Heart

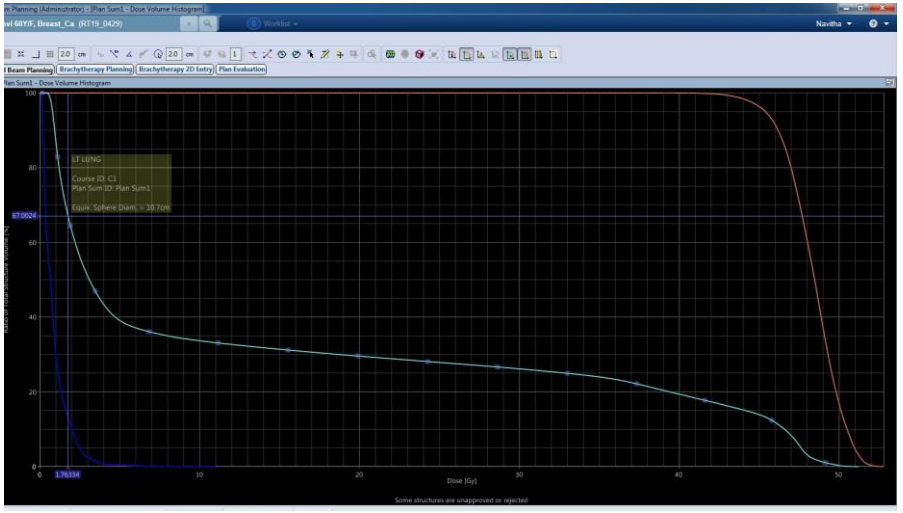


Opposite Breast

Lung







Take Home Messsage

- Know your anatomy (3D, surface and radiological)
- Delineation should be cross checked by your peers
- Practice latest techniques, but know your conventional planning (*will help to crosscheck your fields!*)
- Learn from your mistakes & Keep reading…