BASICS OF CONTOURING
CONTOURING OF REGIONAL LNS
3 D CT BASED PLANNING OF BCT AND PLAN EVALUATION

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Why do we need Contouring?

- RT to breast -reduces local recurrences and is a/w improved survival
- Concern- T/t related morbidity in breast and shoulder
  - Long term risk of heart disease and secondary cancer
- Need to Optimize RT to obtain max effect and minimize morbidity
- Transition from 2D to 3D RT– shift from bony land mark based RT to *individualised* target
- Target volume delineation is the weakest link in quality chain of RT and there are large inter observer variations

Basics are still basics!

- Study Pre operative Clinical findings and diagrams well
  - Location of tumour
  - Size of tumour
  - +/- Tumour involving Nipple areola complex
  - PDO- Present/absent and its extent
  - Axillary/ SC LNs

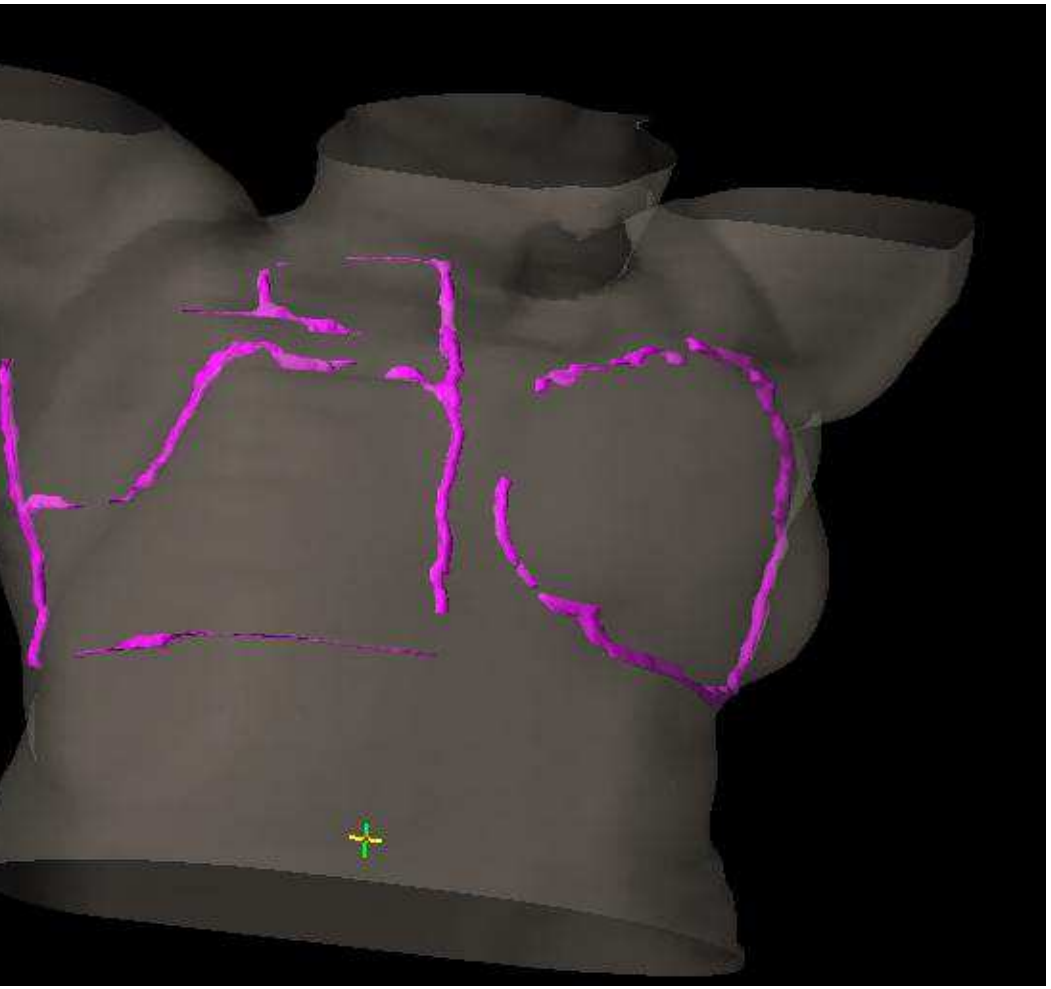
- Read HPR with due attention

Model HPR Post MRM

- 6x4 cm tumour located in UIQ of Rt Breast
- IDC Grade III
- LVI present
- Deep Margin free and 1.5 cm away from tumour
- Tumour reaching up to Dermis
- Dermal lymphatic emboli present
- DCIS absent
- 4/18 LNs Positive ; largest LN 2.5 cm, ECE Present
- Triple Negative

Basics are still basics!

- Understand your patient's body habitus well
- High BMI- sometimes helps you decide arm position/ elevation
- Check for arm's movement
- If any lymphedema- document it
- Type of Breast-
- Atrophic – careful palpation
- Pendulous breast -identify and try to reduce folds
- Location of tumour- Tumour in Lower quadrant or inner quadrant- need to modify conventional borders



CT Simulation

- Position- Comfortable and reproducible
- Supine
- Breast wedge
- Both arms above head
- IV Contrast Optional (we use IV Contrast only in patients with Positive SCF nodes)

- Wires-Important Step- Do not hurry!!
- Palpate Breast well, look for skin folds, mark with pen both breasts
- Wire around- I/L Breast
  Scar
  Opposite Breast
  Provisional field borders

Use copper wires to reduce artefacts

Free Breathing

3- 5 mm scans from neck to L1-2

Pic Courtesy Dr Ashwini Budrukar

Terminology

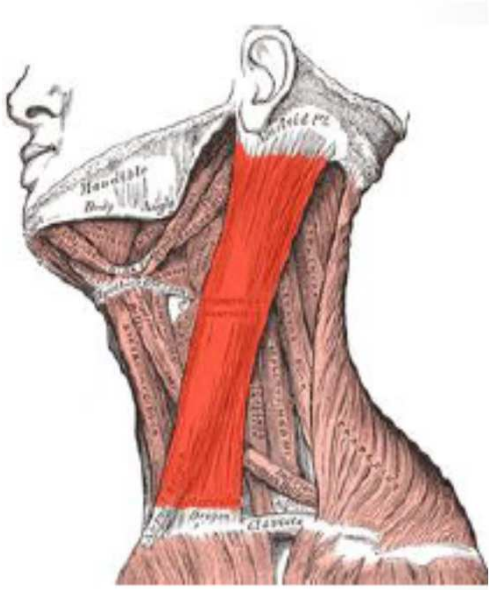
- Medial, Lateral, Cranial, Caudal, Ventral, Dorsal
- G- Guideline
- MS- My Submission

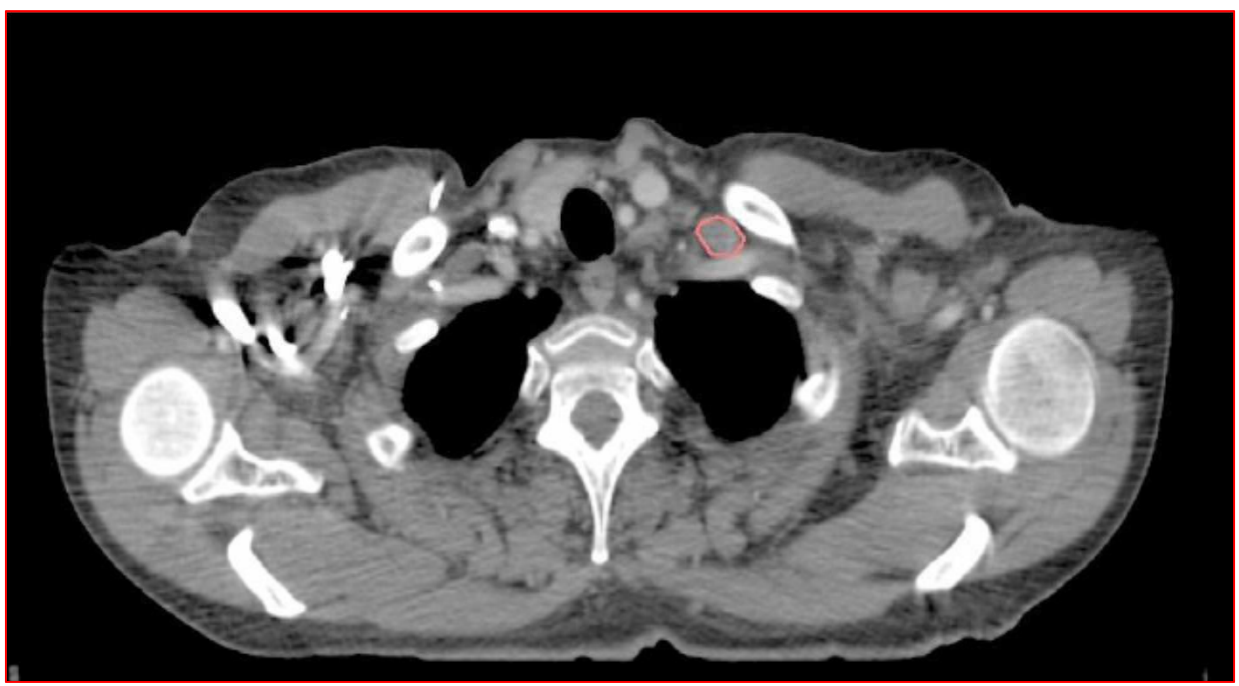
Normal Anatomy

M- Superficial
s in Neck

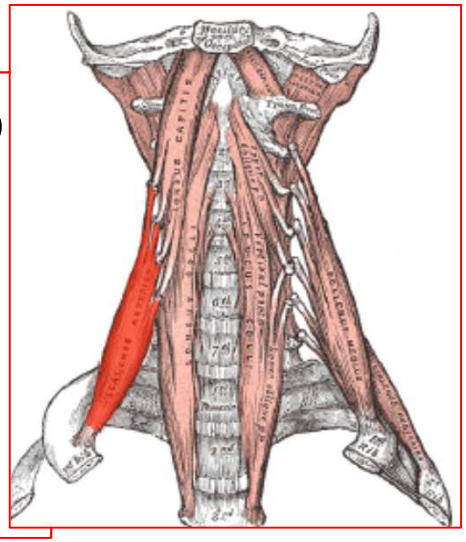
Manubrium
erni & Medial
avicle

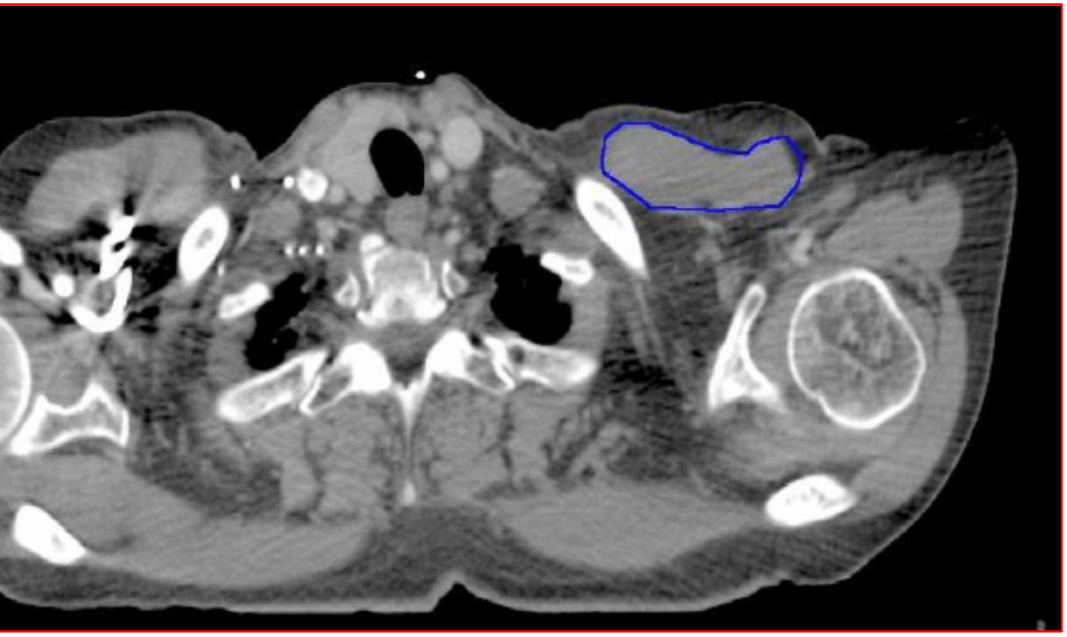
Mastoid process





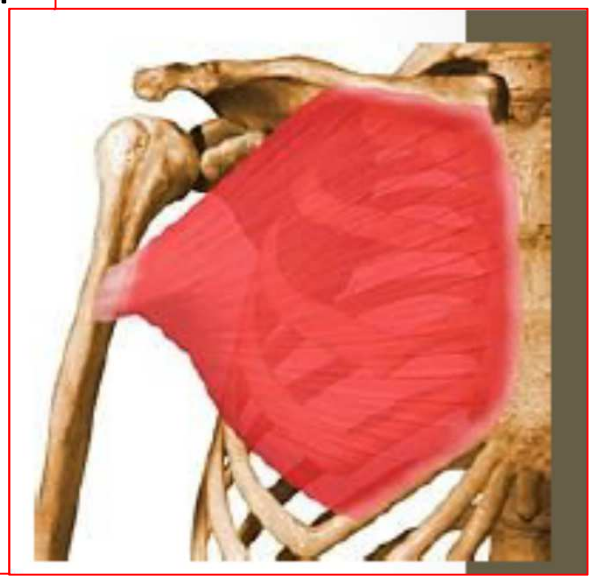
Scalene Ms –Deep
Neck Ms
O- Transverse
process of C3-6
- First Rib



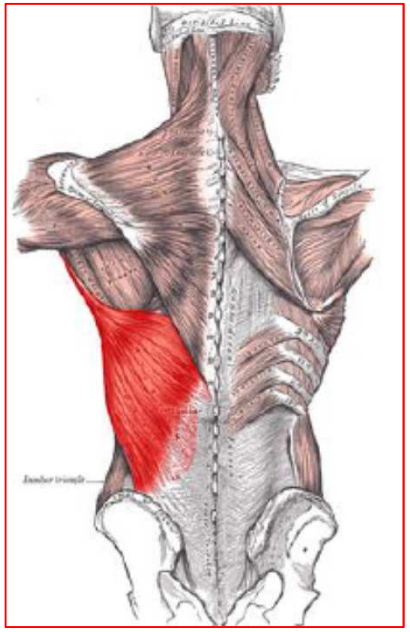


Major- Thick fan shaped

i) Clavicular head
Sternocostal head-
terior surface of
rnum and superior six
stal cartilage
lumerus



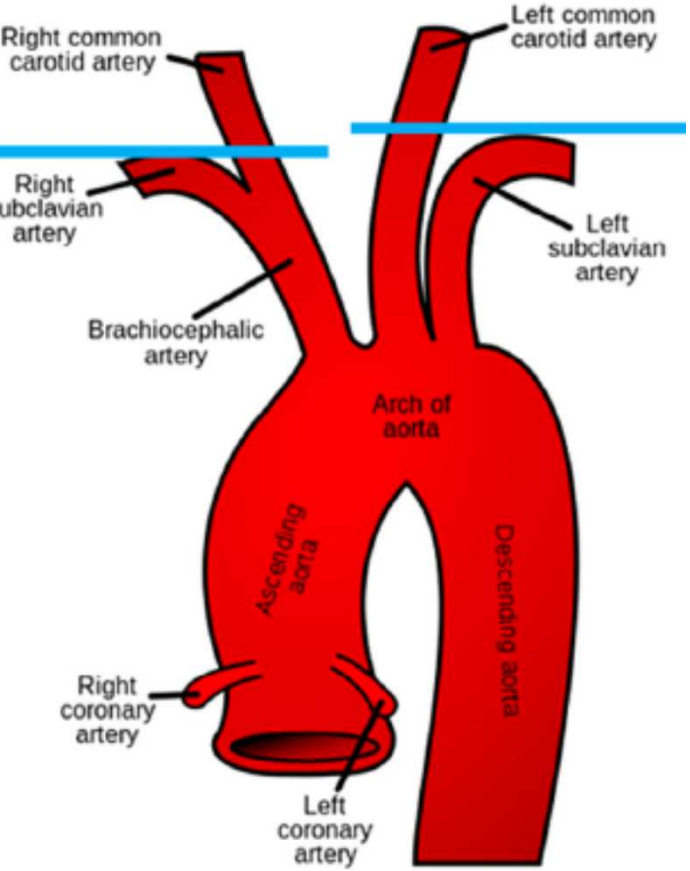
Minor- Thin triangular Ms
3-5th Rib
Coracoid process of
apula

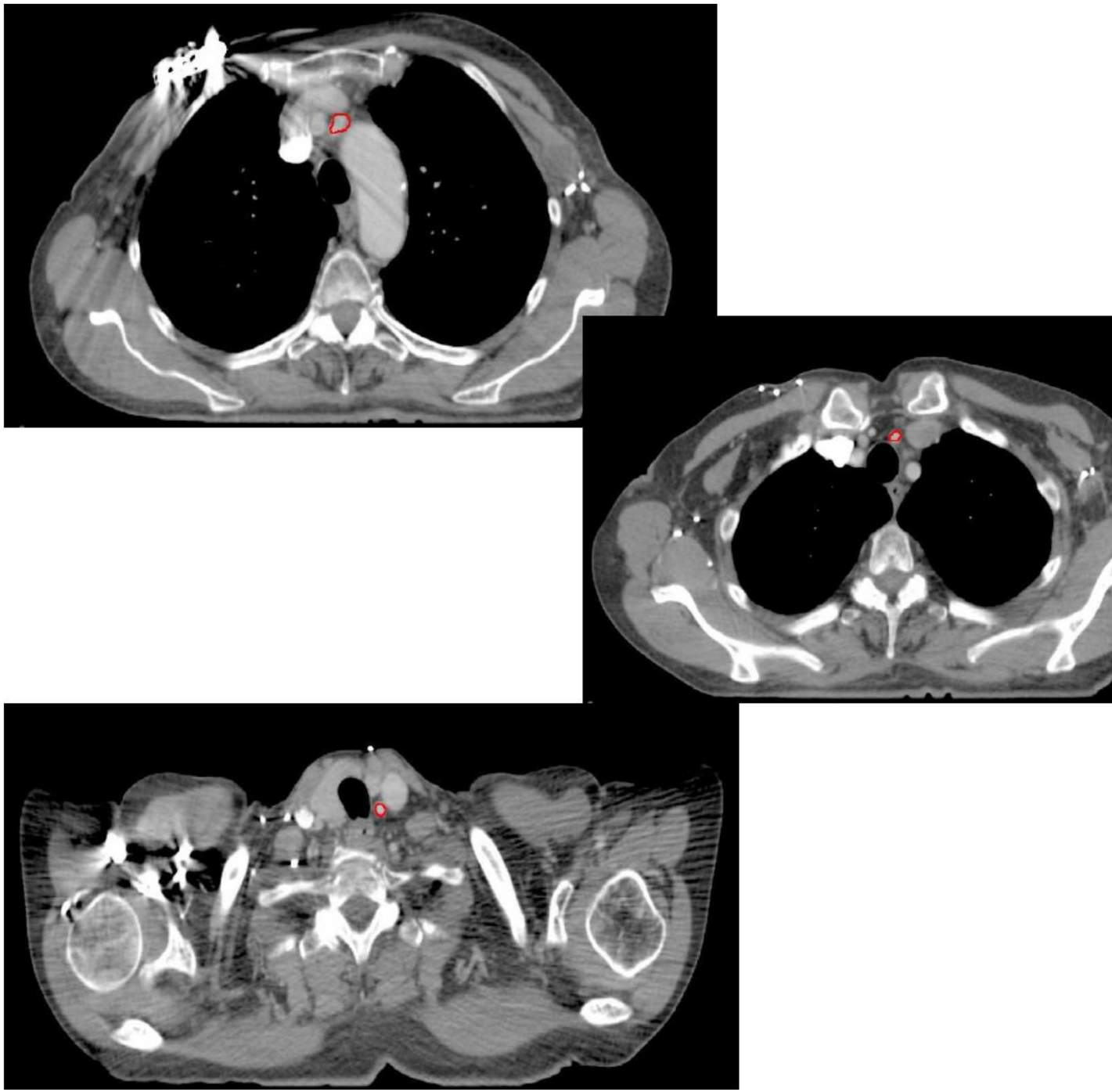


capulae- Large flat

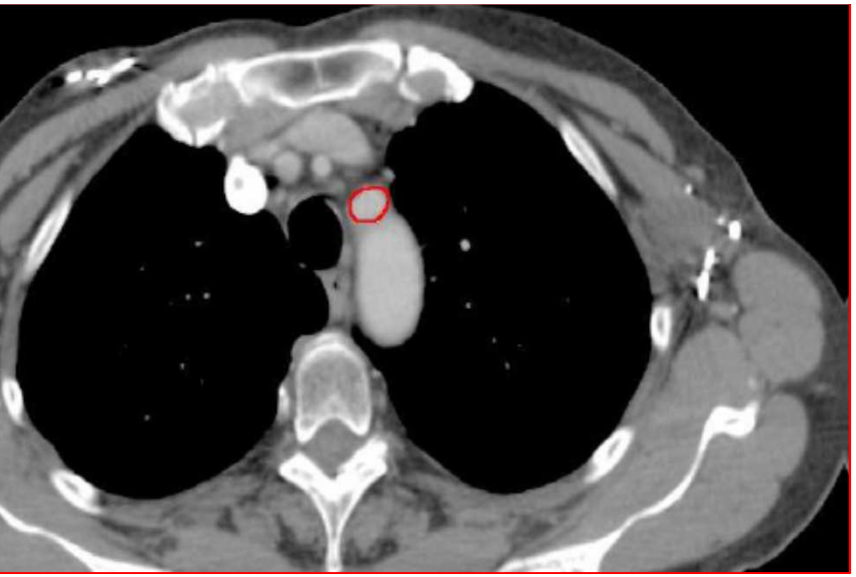
Scapula
3rd or 4th Rib
D7-L5 Vertebrae
Iliac Crest

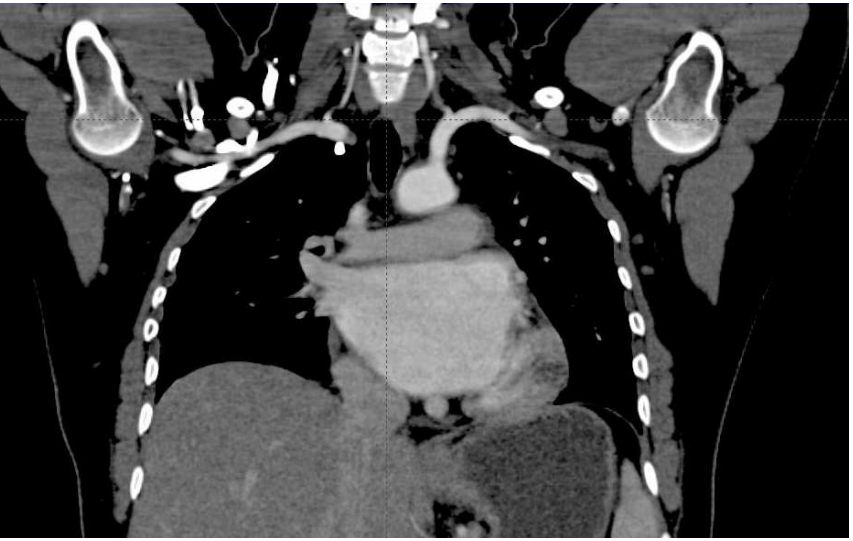
Humerus

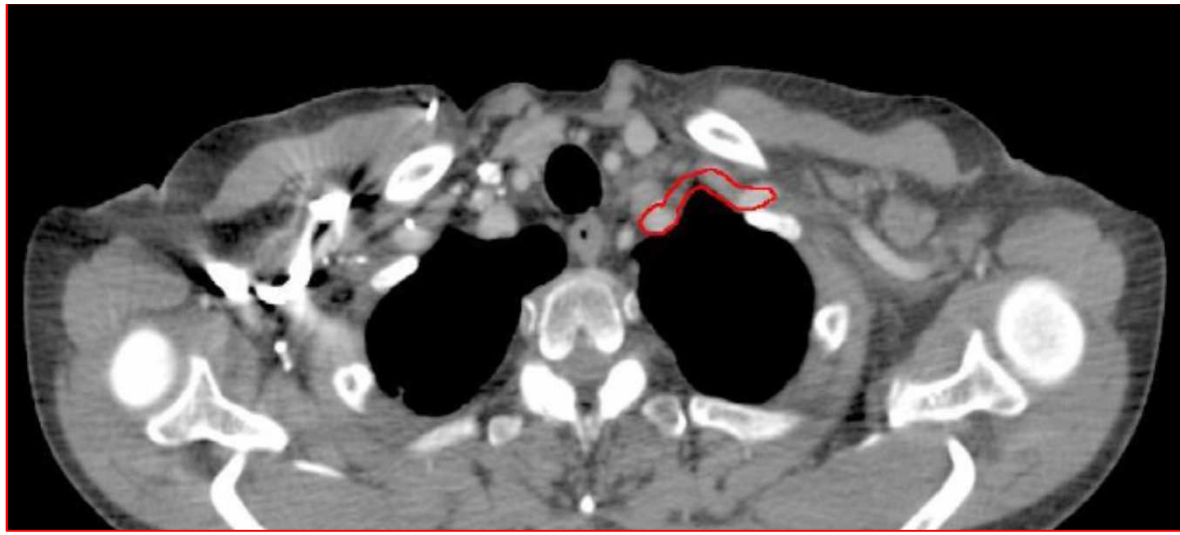




rigin-
ft CCA- Aortic Arch
ght CCA- Right Brachiocephalic A





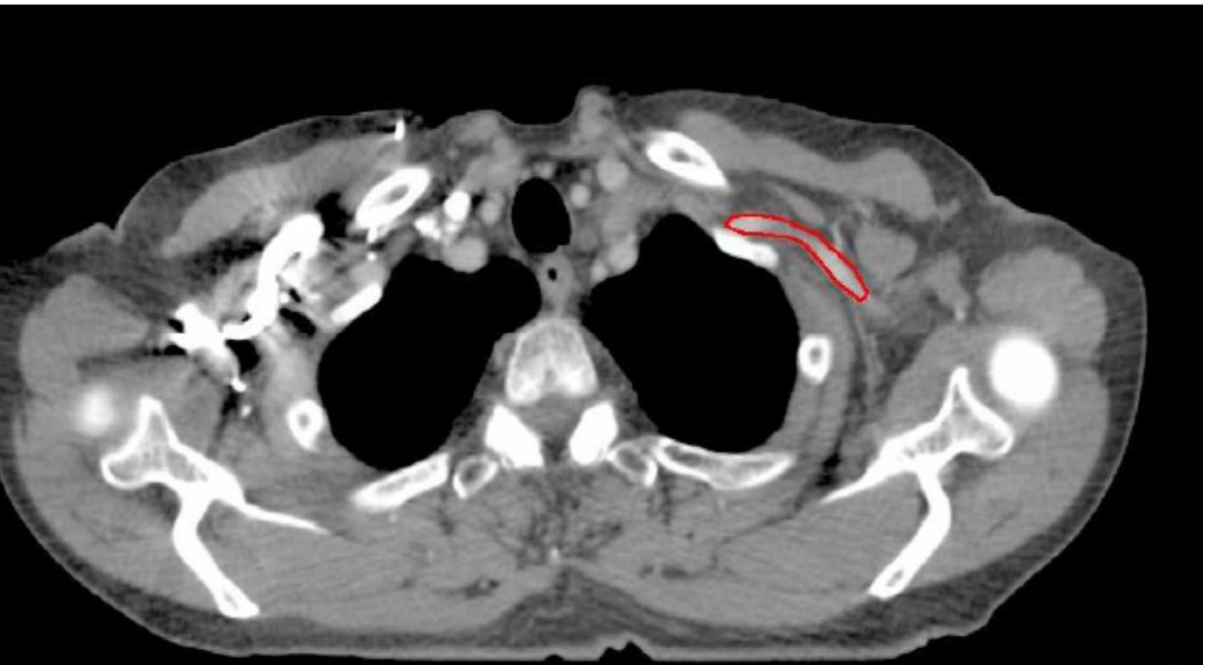


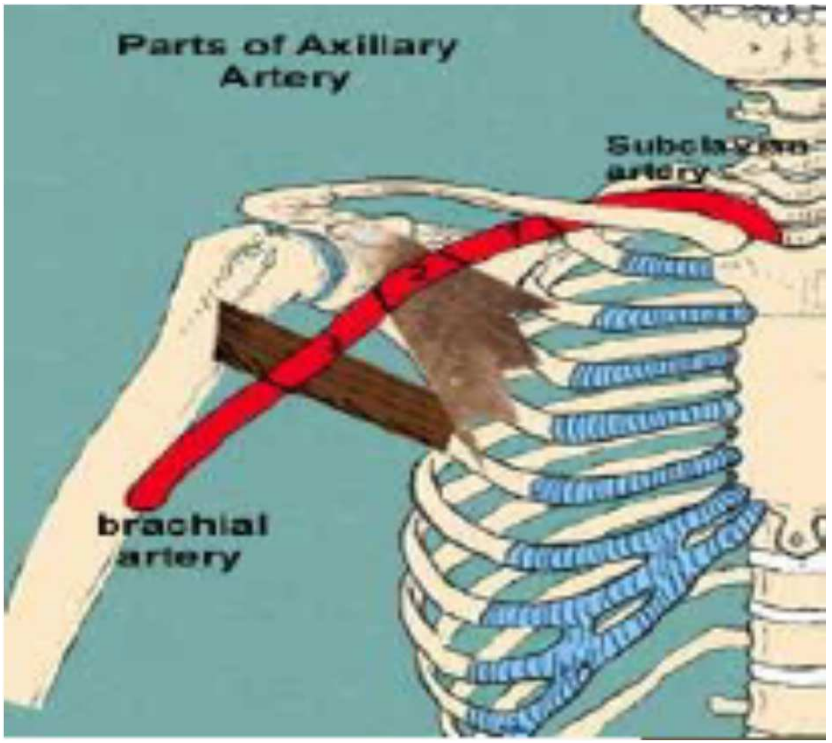
SCA- Aortic arch

SCA- Brachiocephalic Trunk

er Crossing Lateral Border of first rib it

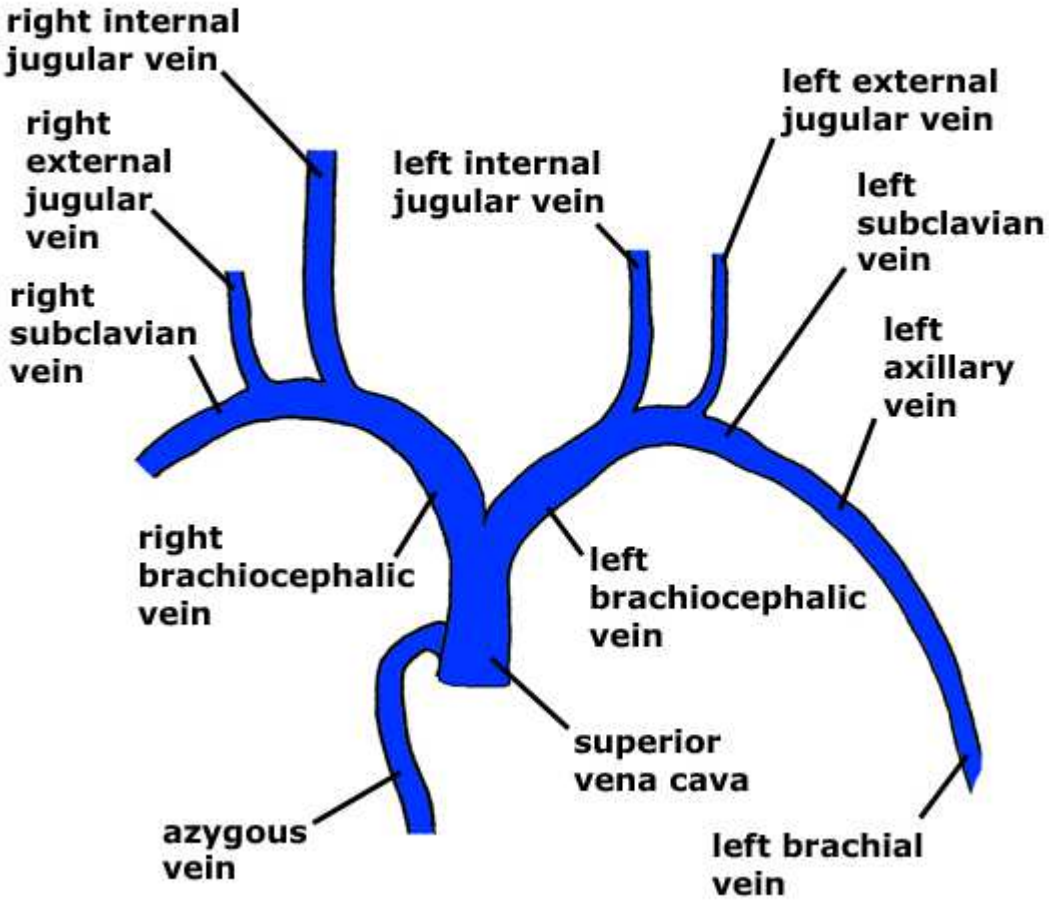
comes axillary A





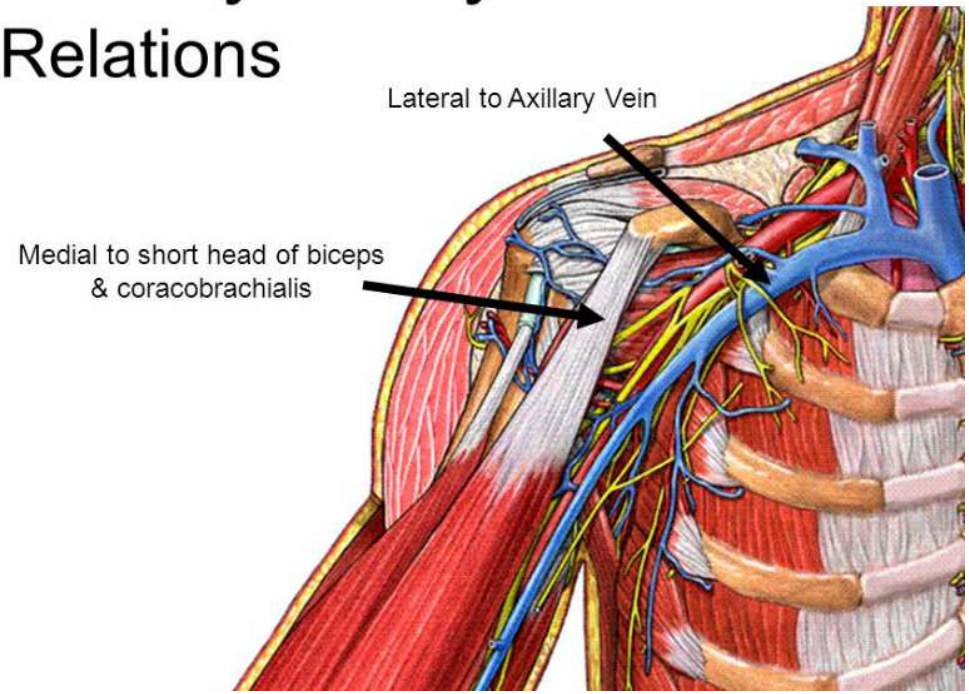
Axillary A- Three parts medial, posterior and lateral to P Minor Ms

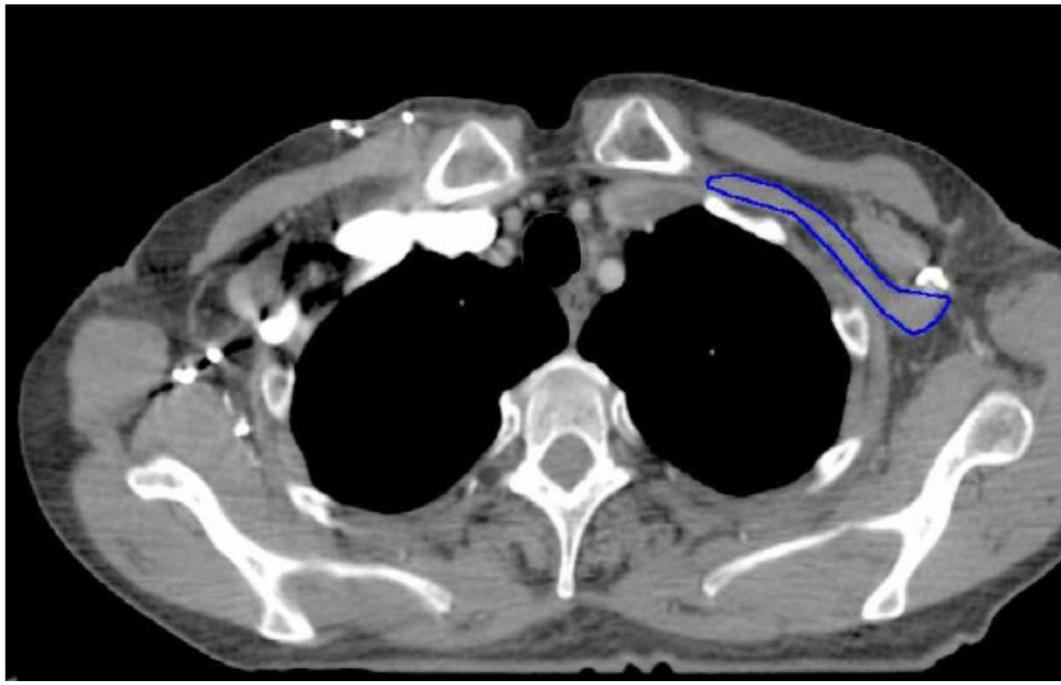
Major veins superior to the heart

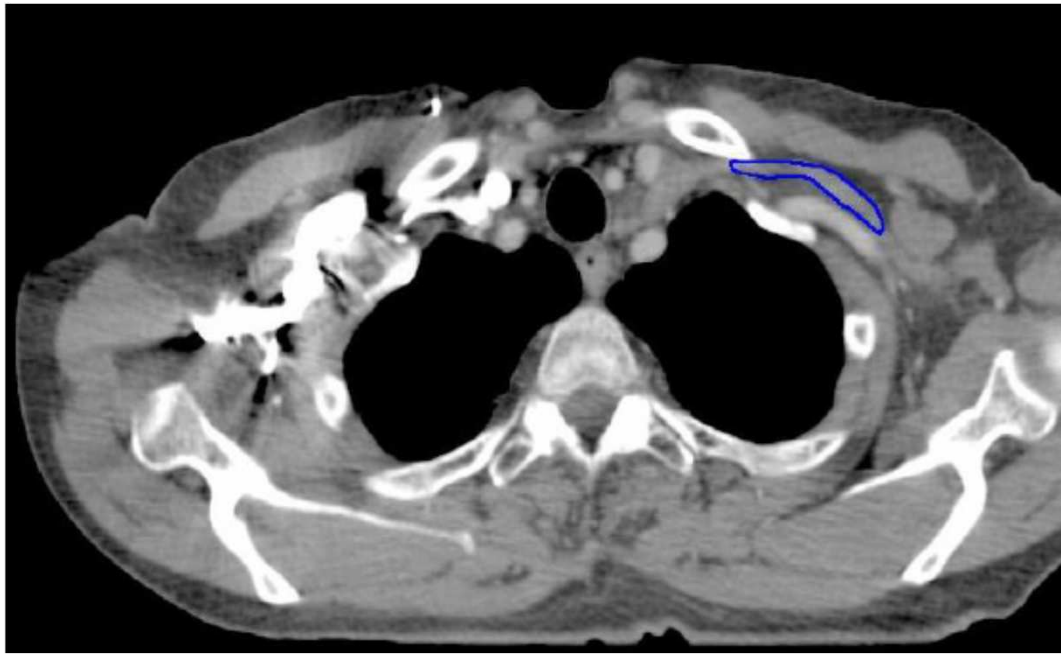


Axillary Artery

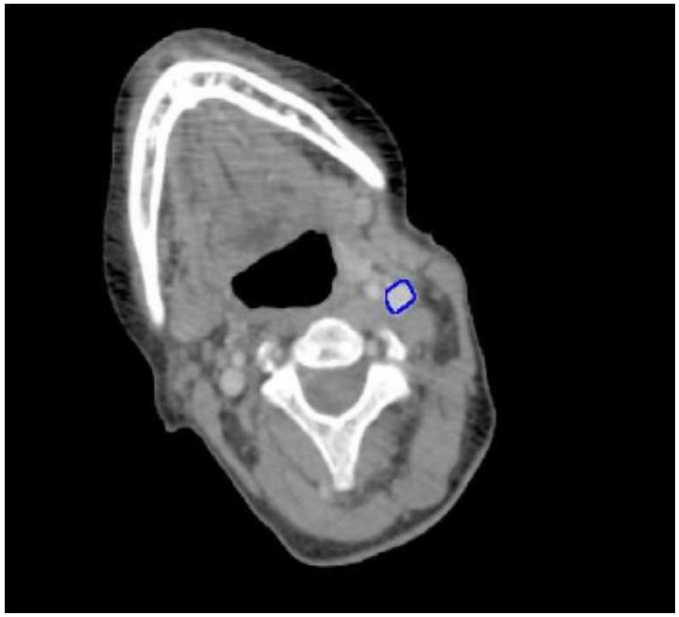
Relations

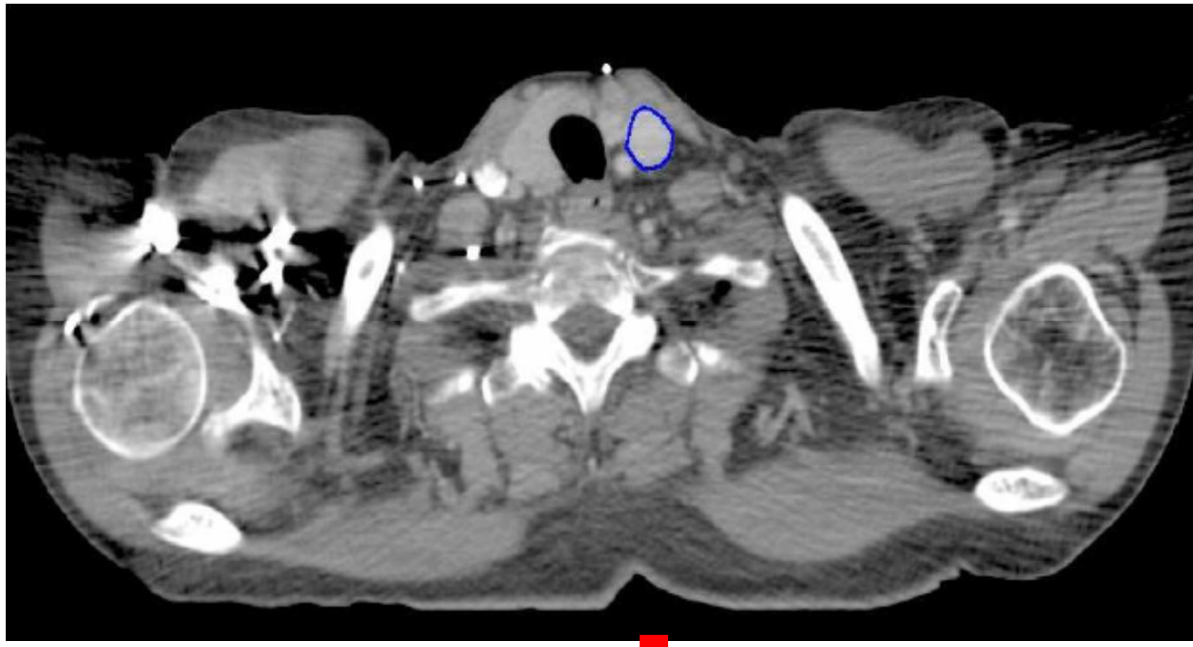


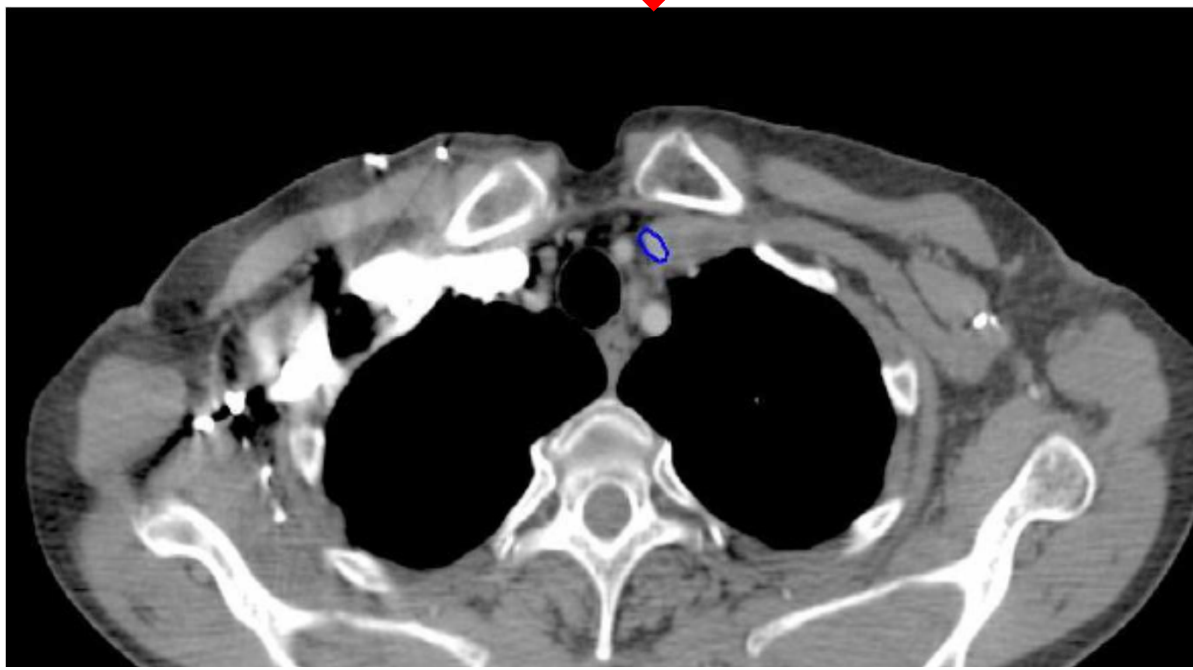




Axillary V – Drains in Subclavian V







IJV- Unites with Subclavian V to form Brachiocephalic V

Why wires around Breast?

- Large differences are reported b/w CTV localization using standard anatomic borders, palpation and USG
- Hurkmans et al - study in 2001 with palpable breast glandular tissue was marked by lead wire before Planning CT in 6 pts Vs. 4 patients without lead wire
- CTV was delineated by 4 RO
- Deviations in PTV extent were greater in Posterior, Cranial and medial directions
- Interobserver variation in volume was decreased by a factor of 4 on scans with lead wire

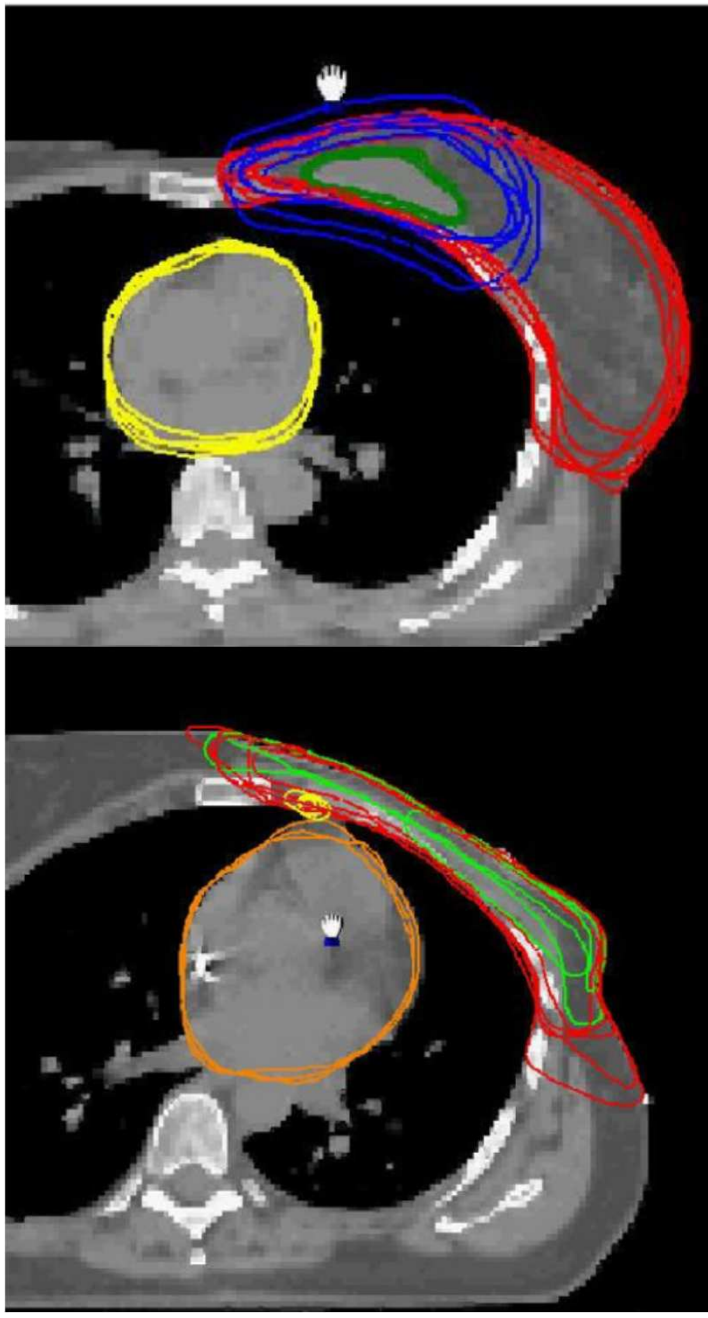
IJROBP Vol 50 No5, 2001

RTOG Atlas

- 9 RO from eight institutions independently delineated targets

(Lumpectomy cavity, boost PTV, Breast, SCF, Axillary, IMCLN and chest wall) and OARs (heart and lungs) on same CT images of three representative breast cancer pts

To reduce inconsistencies RTOG proposed a breast cancer atlas



IJRBOP Vol 73(3), 944-51; 2009

east Cancer Atlas for Radiation Therapy Planning:
Consensus Definitions

RTOG
RADIATION THERAPY ONCOLOGY GROUP

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

Breast Contouring
RADCOMP Consortium

v.3

February 23, 2016

Acta Oncologica, 2013; Early Online: 1–8

info
healthcar

ORIGINAL ARTICLE

Delineation of target volumes and organs at risk in adjuvant radiotherapy of early breast cancer: National guidelines and contouring atlas by the Danish Breast Cancer Cooperative Group

Radiotherapy and Oncology 114 (2015) 3–10

Contents lists available at ScienceDirect

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com

ESTRO consensus guidelines

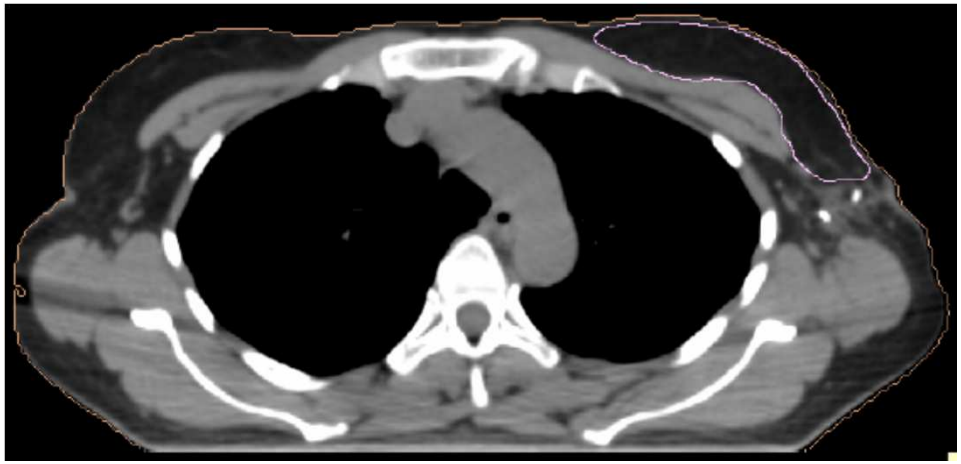
ESTRO consensus guideline on target volume delineation for electi radiation therapy of early stage breast cancer

Guidelines only Guide!!

- Guidelines serve as base on which CTV can be individually adapted
- Not applicable for T/t in prone position
- RTOG – EBC and LABC
- ESTRO and Danish- EBC
- All Contours are shown- does not mean that all volumes have to be treated

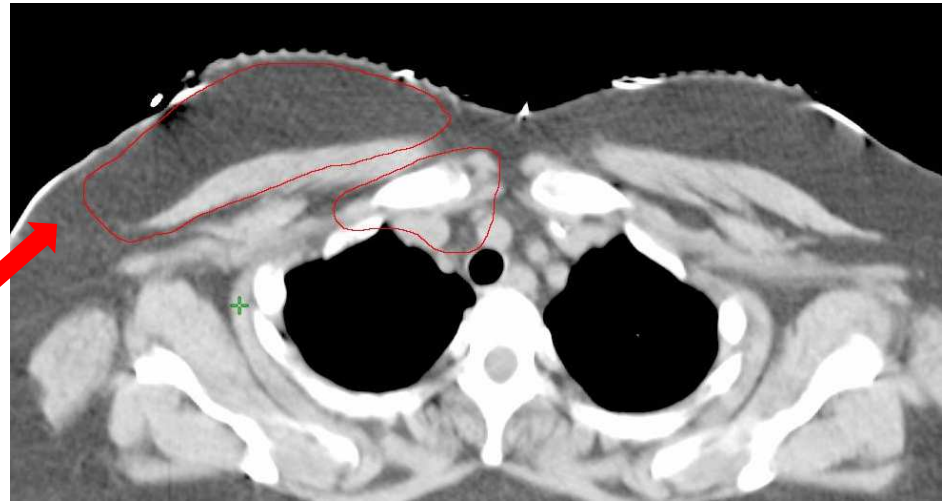
CTV Breast

CTV - Total glandular breast tissues

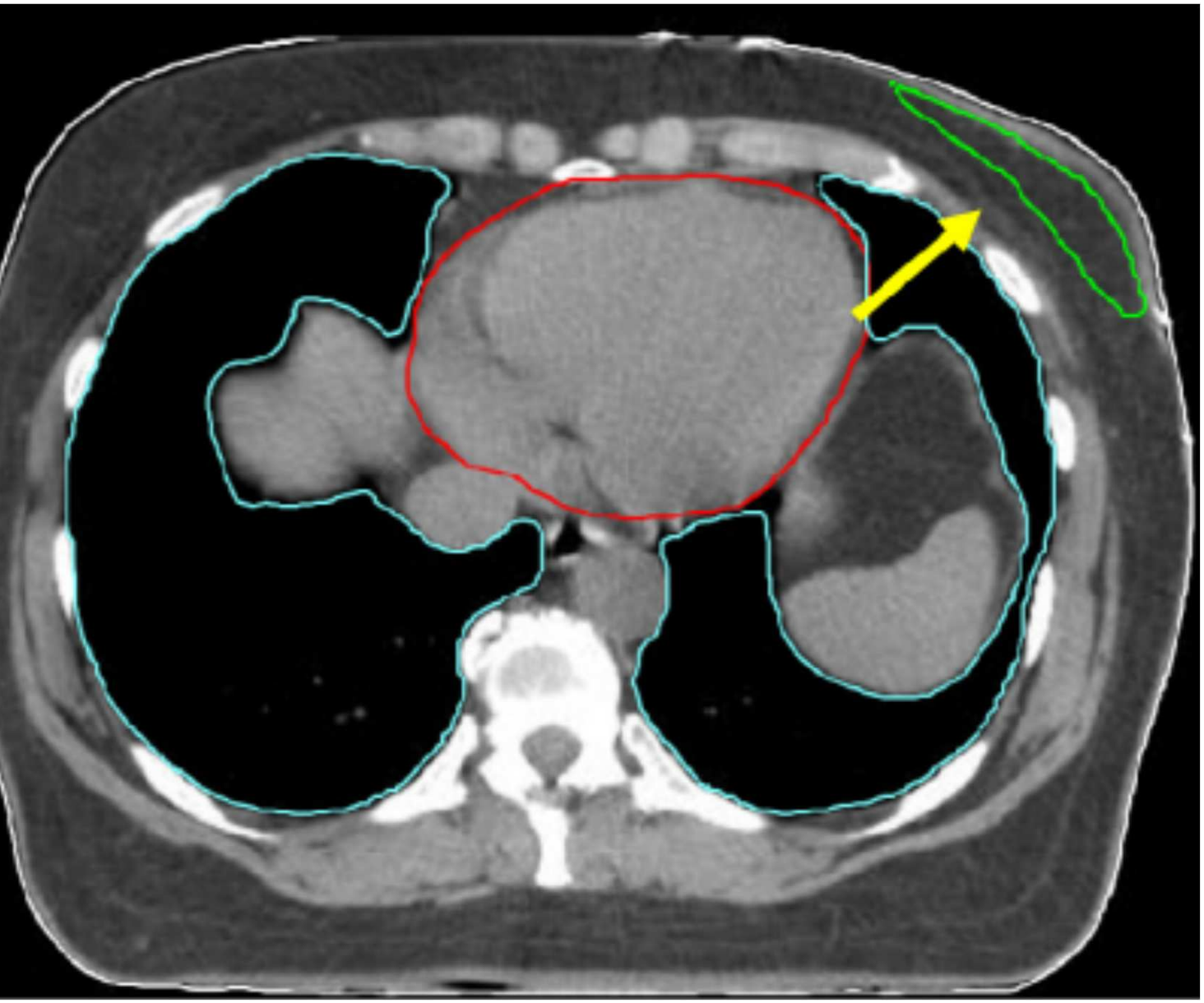


Cranial- Uppermost level of Palpable/ Visible Breast tissue

Maximally up to inferior edge of ternoclavicular joint (G)



In high BMI patients or patients with large breast, sometimes breast tissue goes above



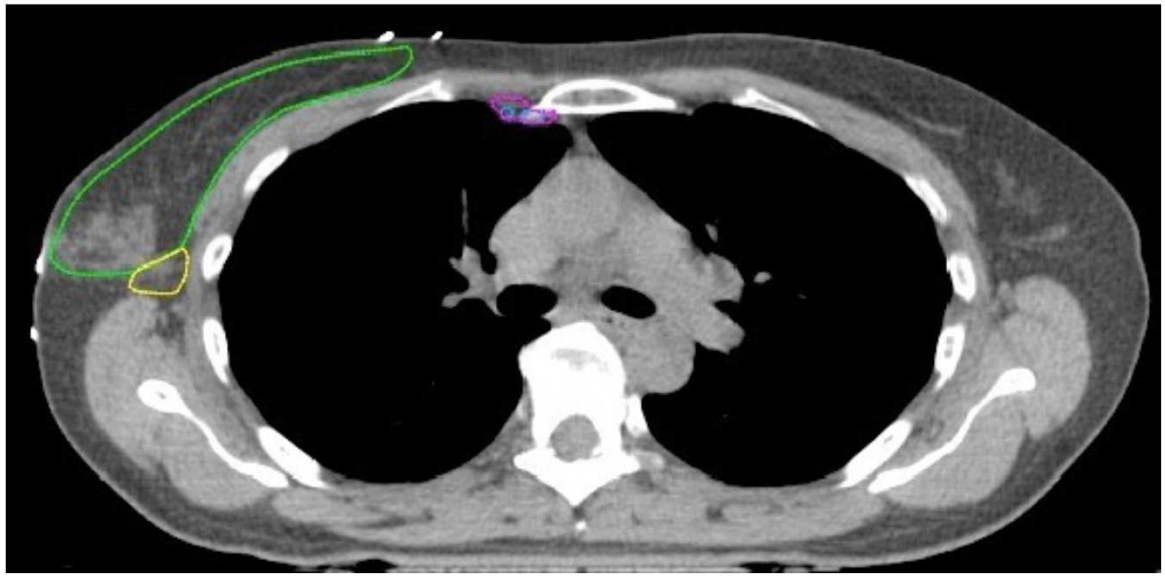
Caudal- Most Caudal CT slice with visible breast tissue (G)

In obese patients, CTV P Breast is positioned more ventrally in the caudal part of breast due to fatty tissue (G, ESTRO)

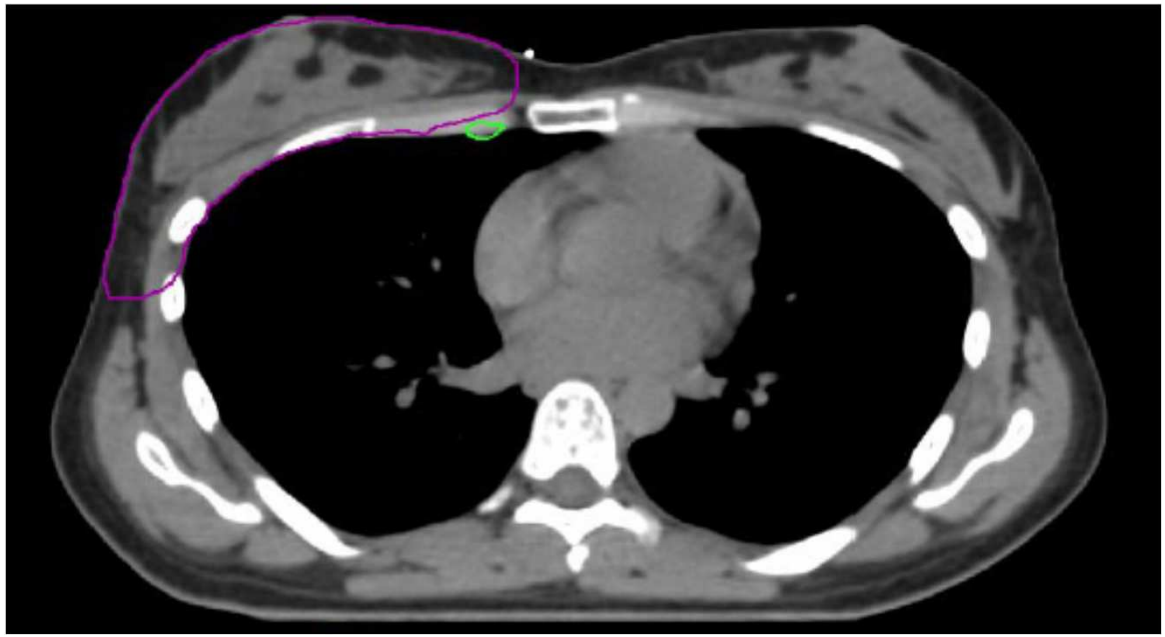
This is actually extension of abdominal wall fat

Helps decreasing dose to heart

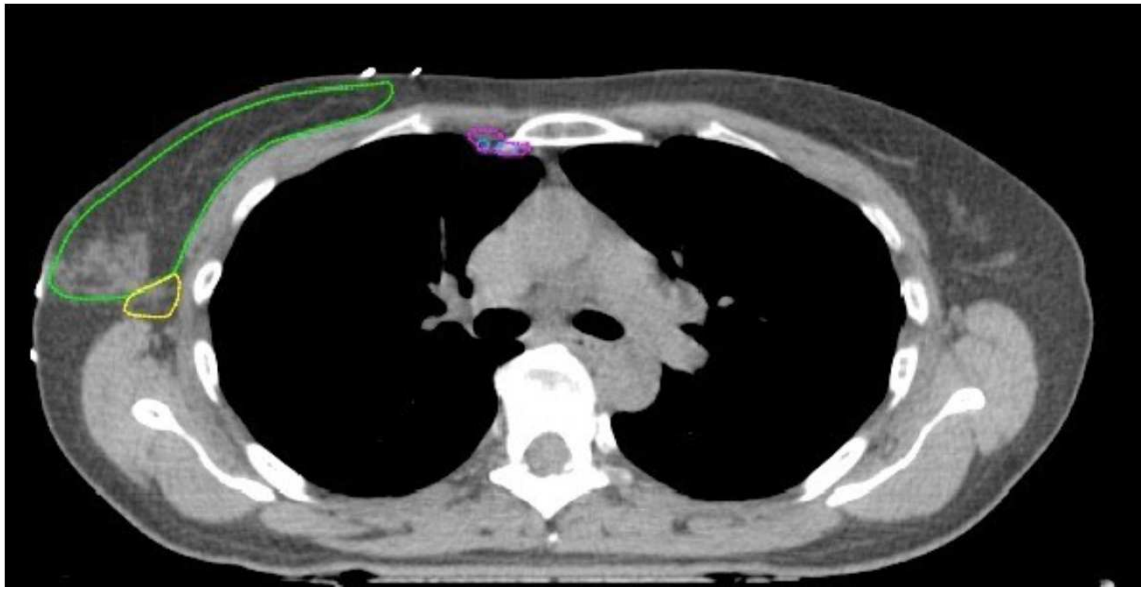
- Dorsal – Pectoral muscle or intercostal ms where there is no P Major muscle (G)



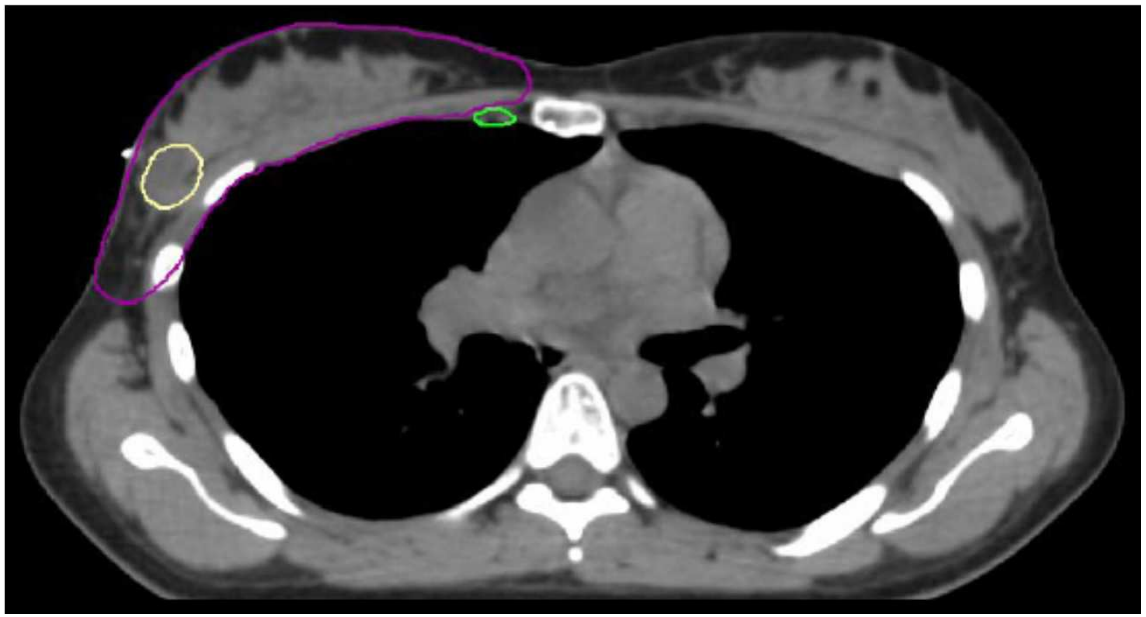
- RTOG – to include chest wall also in LABC



entral- 5mm under skin
G, ESTRO)

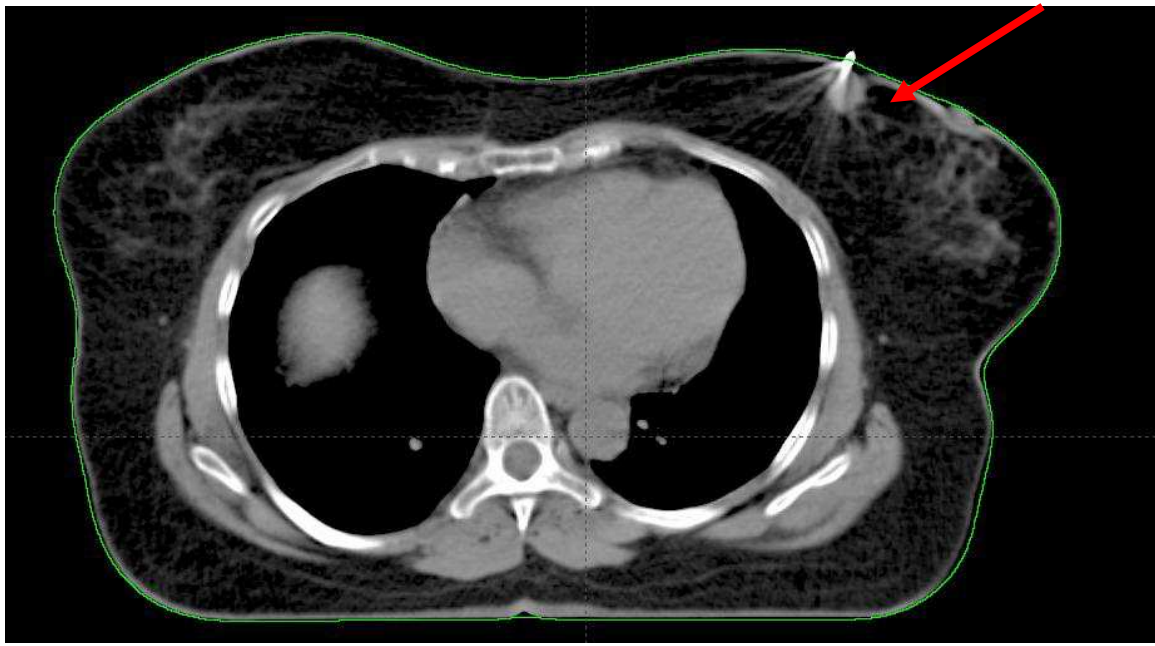


ABC with BCS -in cases
ith T4b,c,d cancer where
ll dose up to skin is
dvised (bolus may be
dded) (G, ESTRO, RTOG)

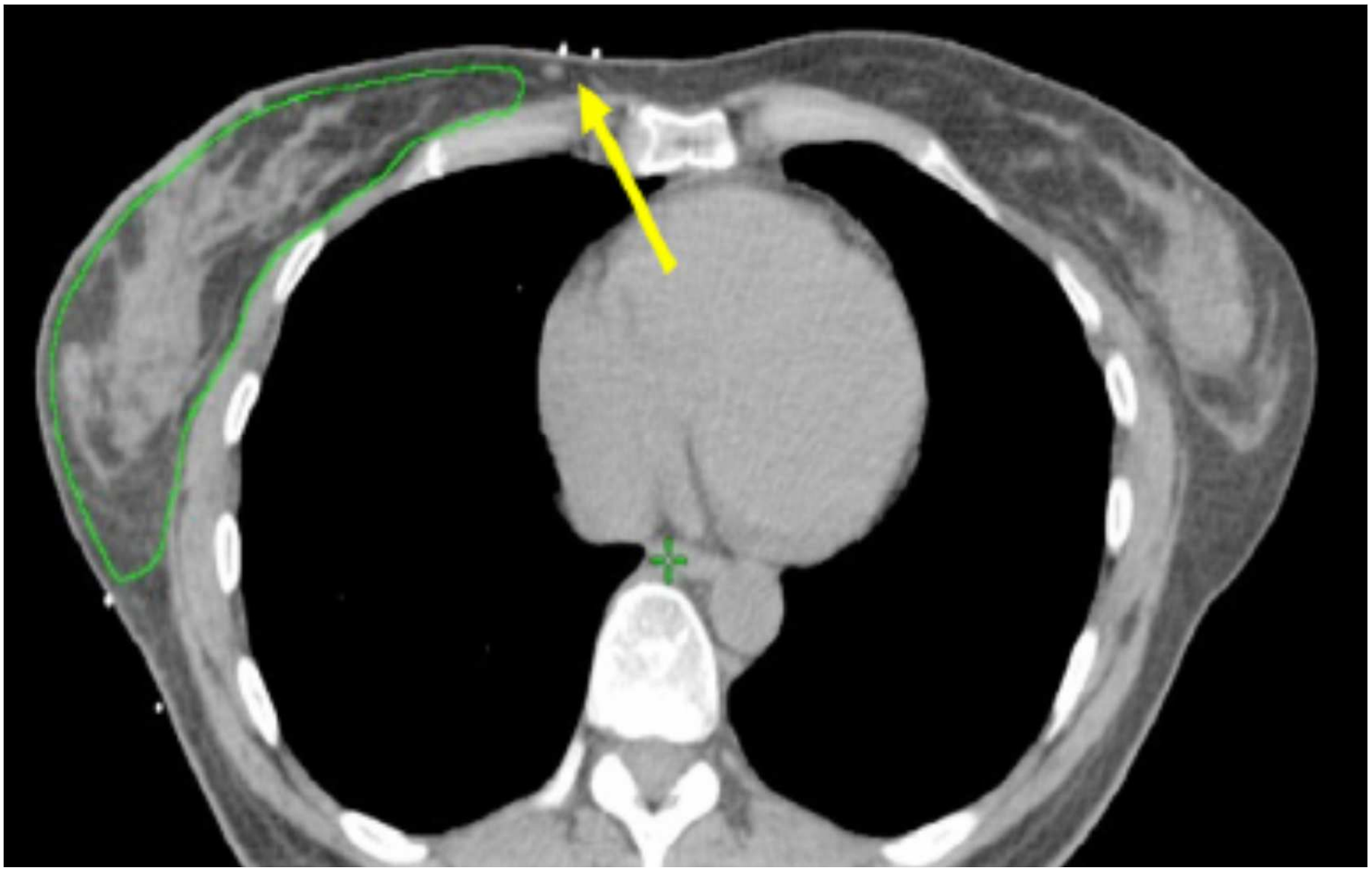


- In a thin atrophic breast one my consider keeping skin volumes may be 3mm below skin (MS)

- In superficially located tumours; skin is also a target; one may consider a small patch of bolus around scar (MS)



Superficially Located Tumour

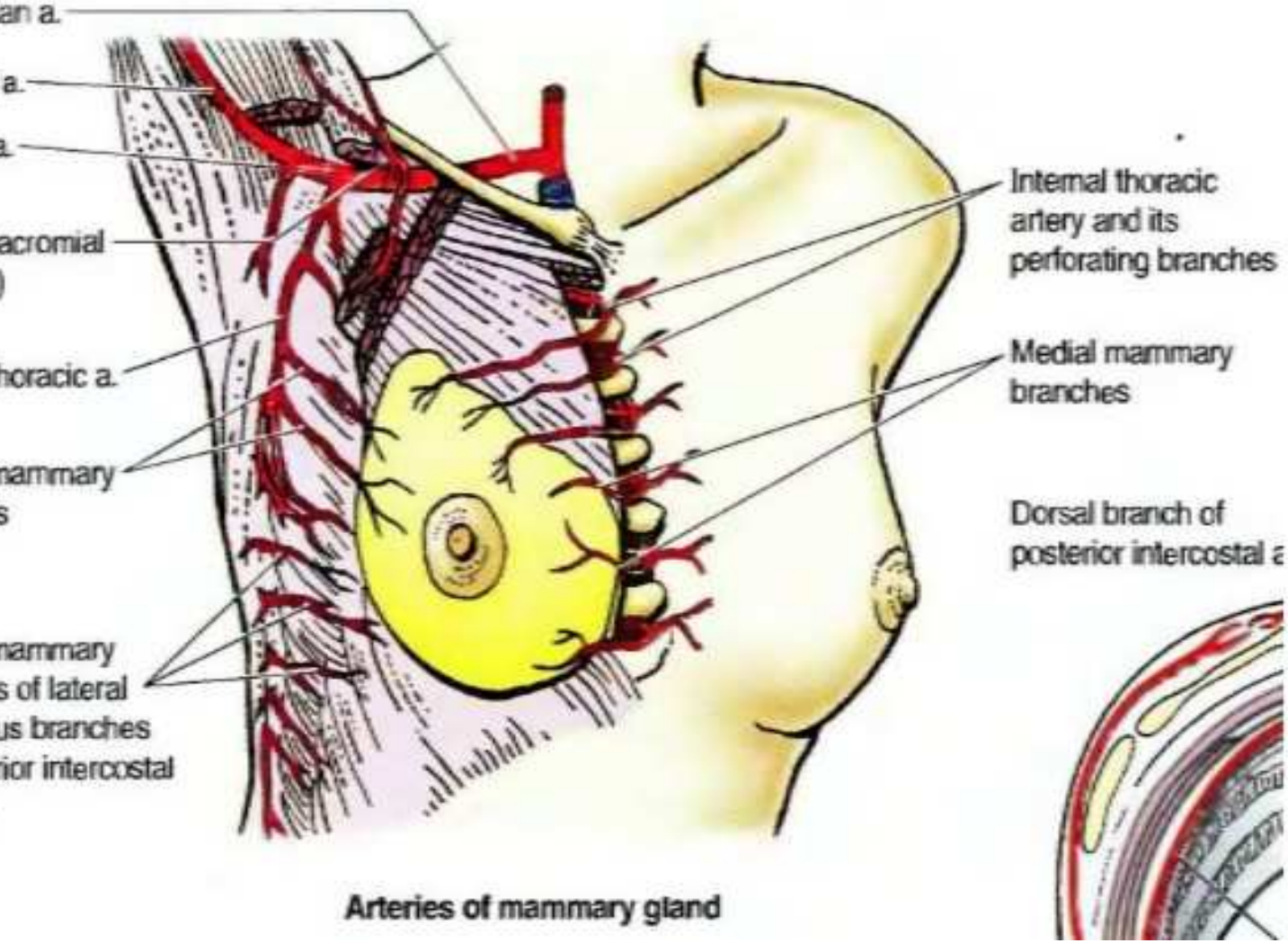


ledial- Clinical Reference / Wire
laximal to edge of sternum
TV P Breast is positioned lateral to mammary branch of internal
horacic A (G, ESTRO)

- Lateral- Most difficult to delineate (varies according to breast ptosis)
- Mid Axillary Line or 1.5-2 cm beyond palpable breast tissue (Traditional)

- Medial to lateral thoracic A, Breast fold (G, ESTRO, DBCG)

- Exclude Lat Dorsi Ms (RTOG)



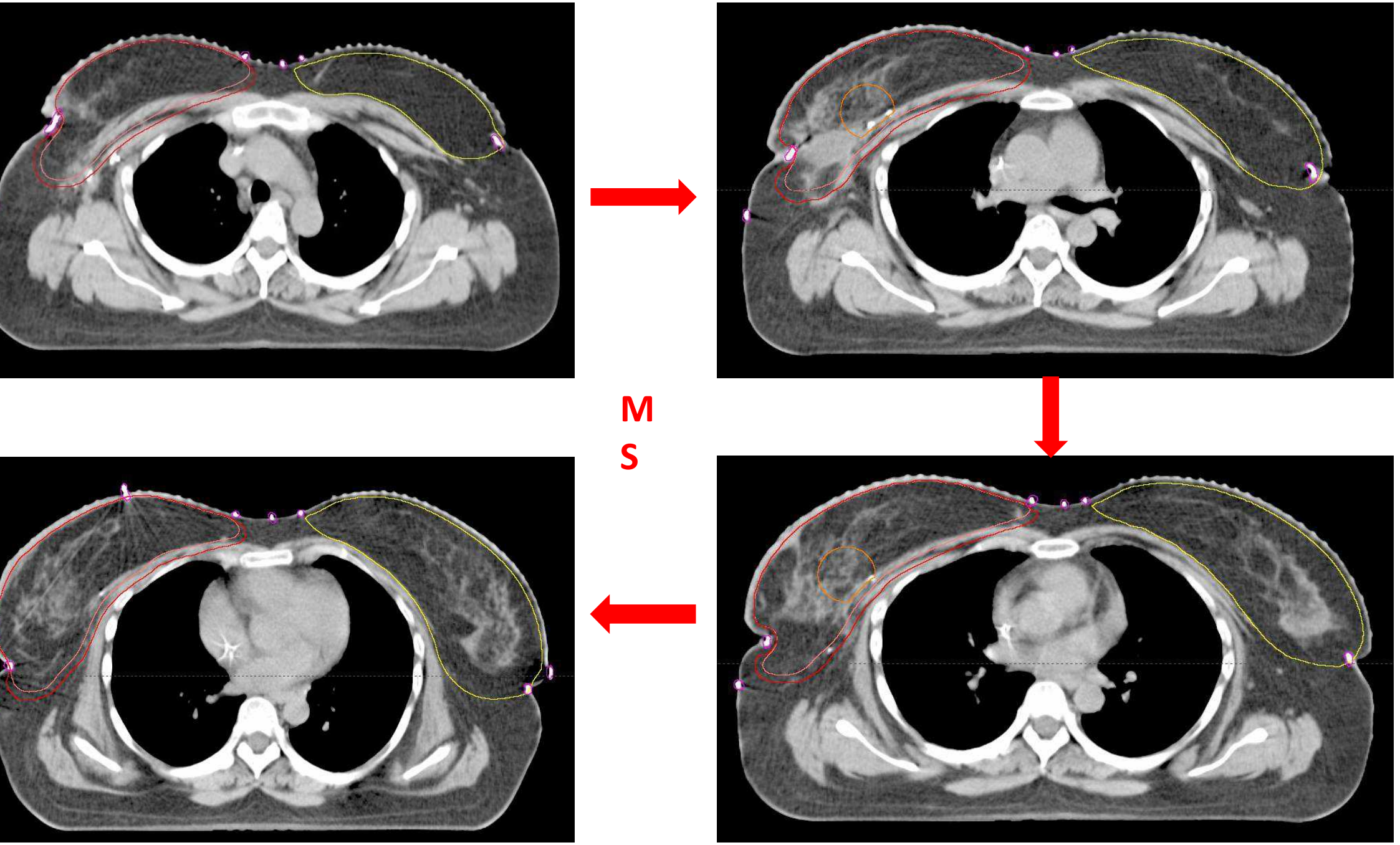
Arteries of mammary gland

Internal Thoracic A is a branch of subclavian A

Lateral Thoracic A is a branch of Axillary A

Words of Caution- Individualization!!

- compass primary tumor bed
  equately , including relevant margins
  ound it
- patients with tumours placed too
  edially/ laterally one needs to modify
  nventional borders
- ply wires carefully even on opposite
  east as you keep comparing your
  ntours with opposite breast


M
S

CTV Chest Wall

- Place radio opaque wires around imaginary- original site of breast and also on MRM scar
- Generally same as breast

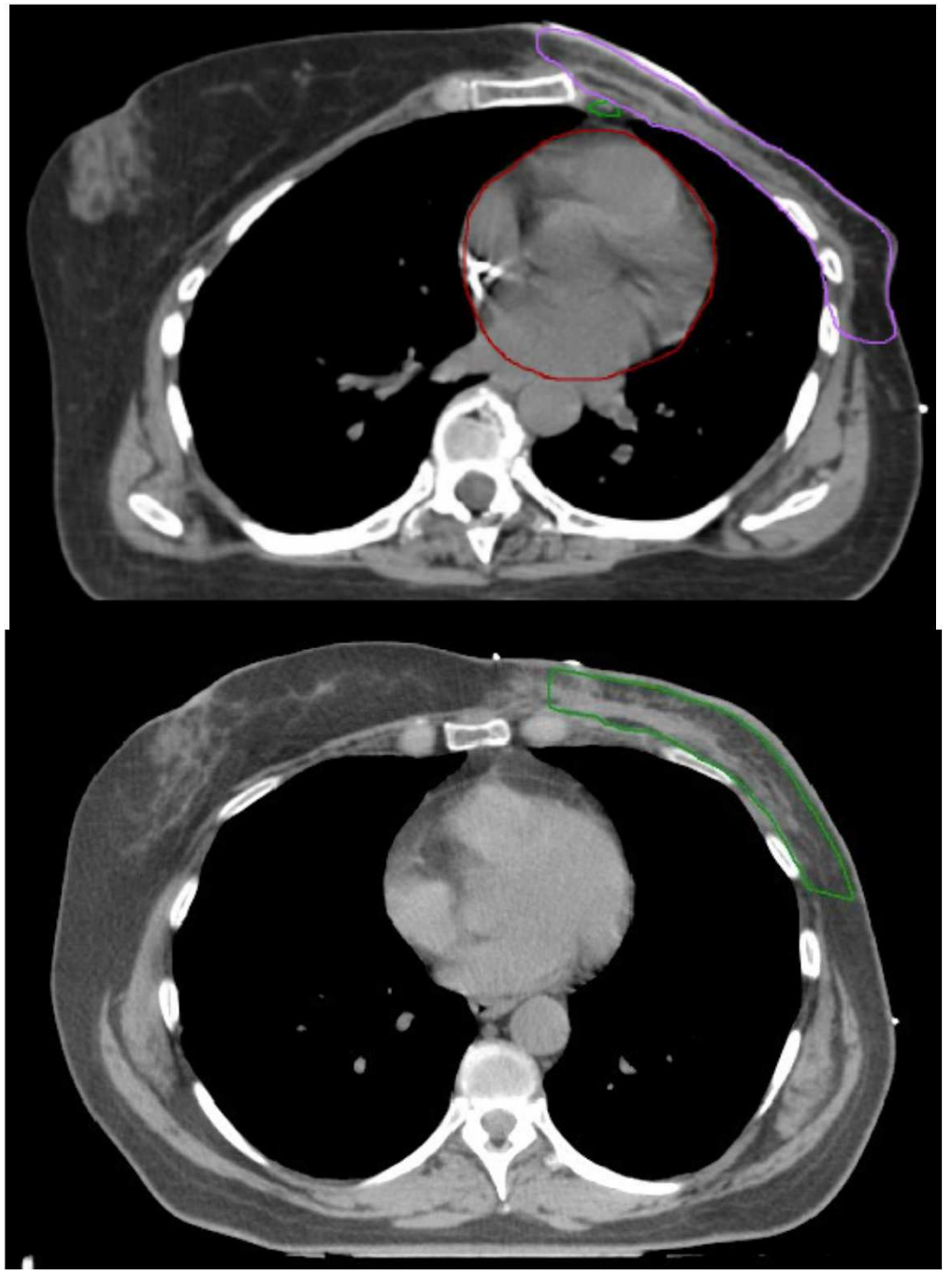
CTV Chest Wall

orsal-

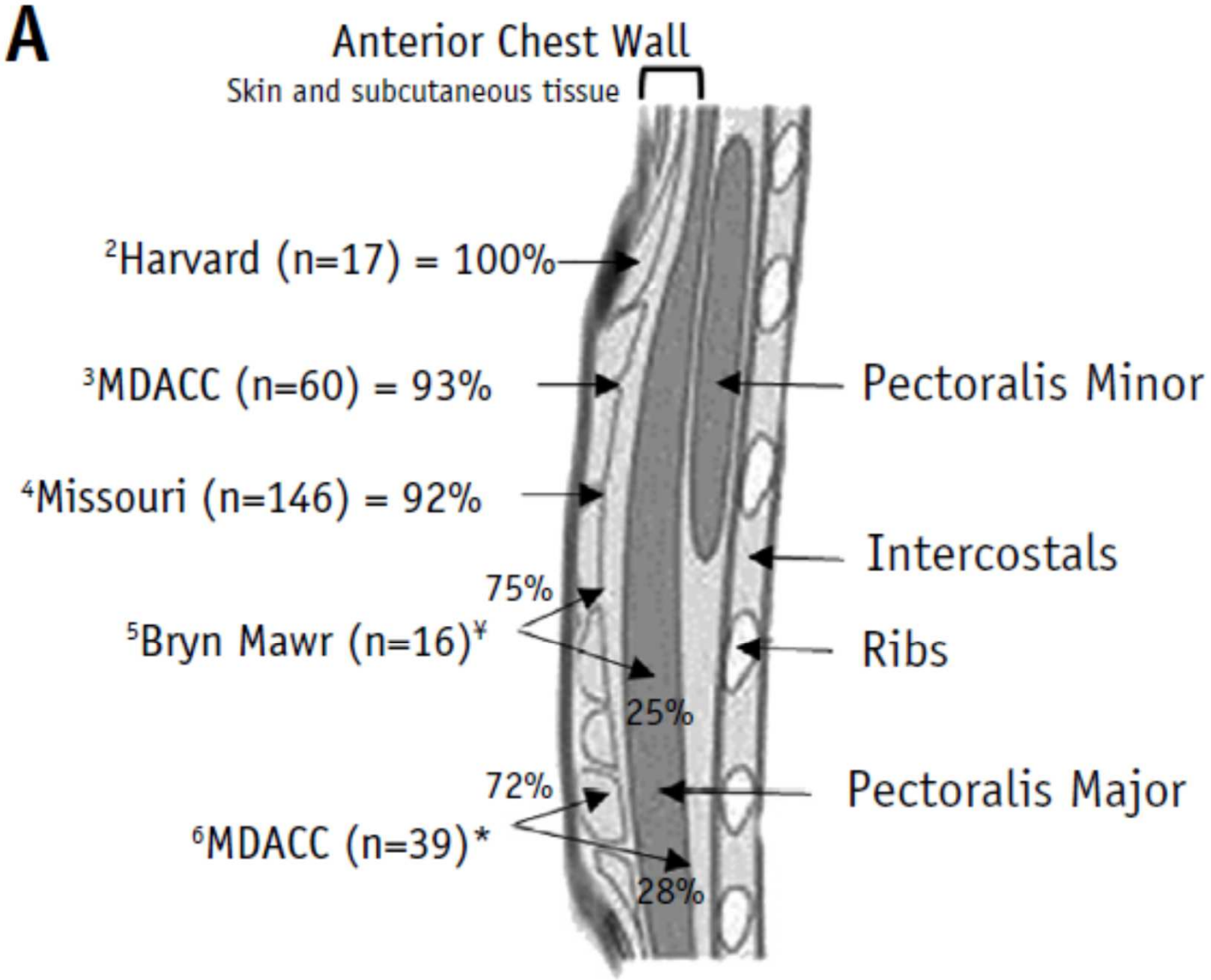
RTOG guidelines- Rib Pleural interface (incuding ribs, IC ms and pectroalis ms)

ESTRO- Unless invasion was demonstrated (tumour stage T4 a-c), no reason to routinely include major pectoral muscle and ribs

Impacts Lung and Heart Doses!



Patterns of failure



IJROBP Vol 93, August 2015, Beriwal et all

Most common site of chest wall recurrence from surgical series (72-100%) is within skin and subcutaneous tissue anterior to pectoralis musculature

Second MC site is within pectoralis

MS- Individualisation

CTV Thoracic W

Ventral-

RTOG- Skin

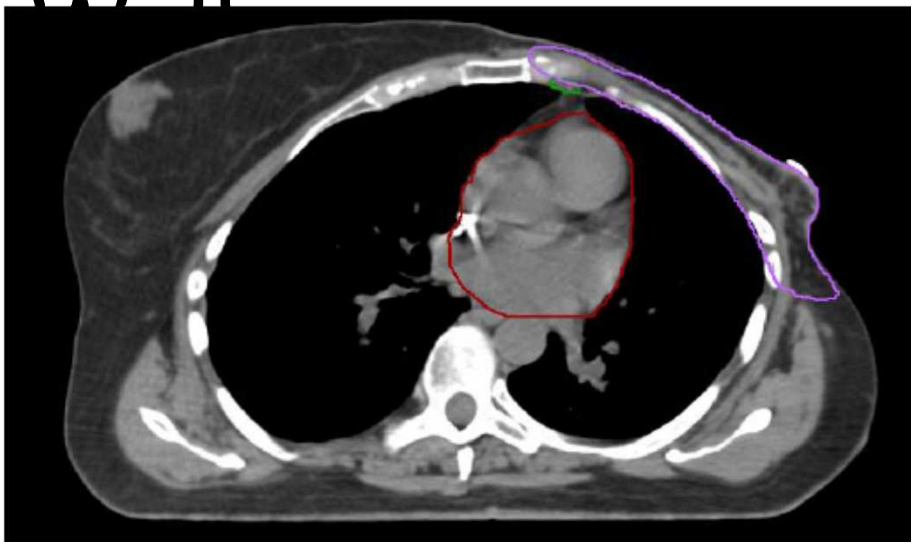
ESTRO- 5 mm under skin surface

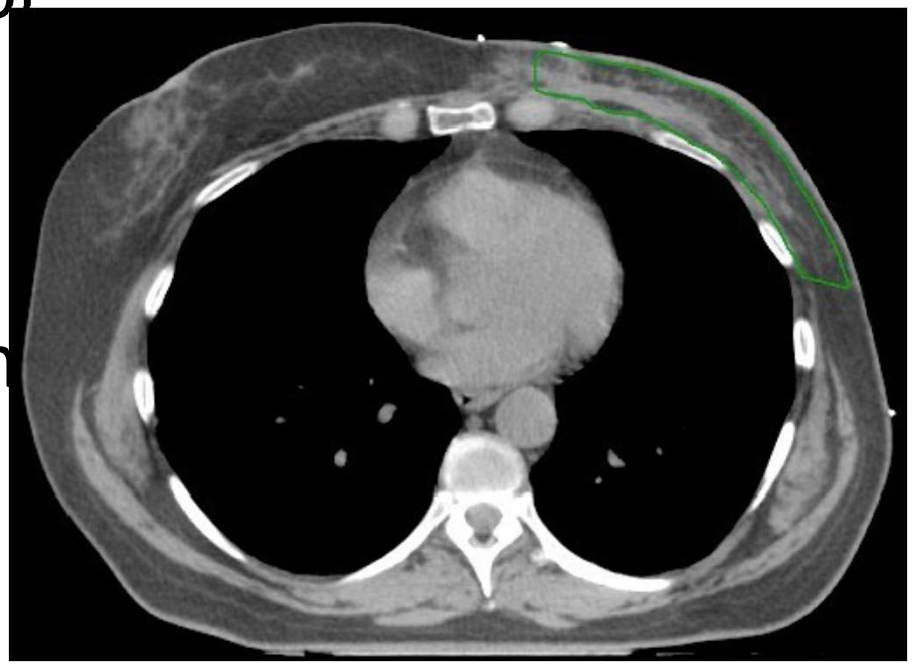
Skin Bolus of 3-5mm may be applied for very thin CW (ESTRO is only for EBC)

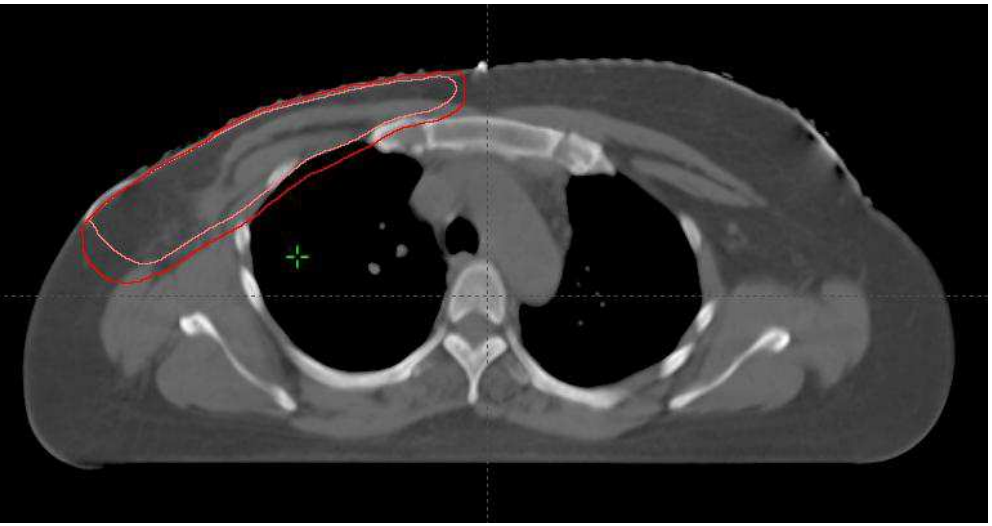
MS -Skin

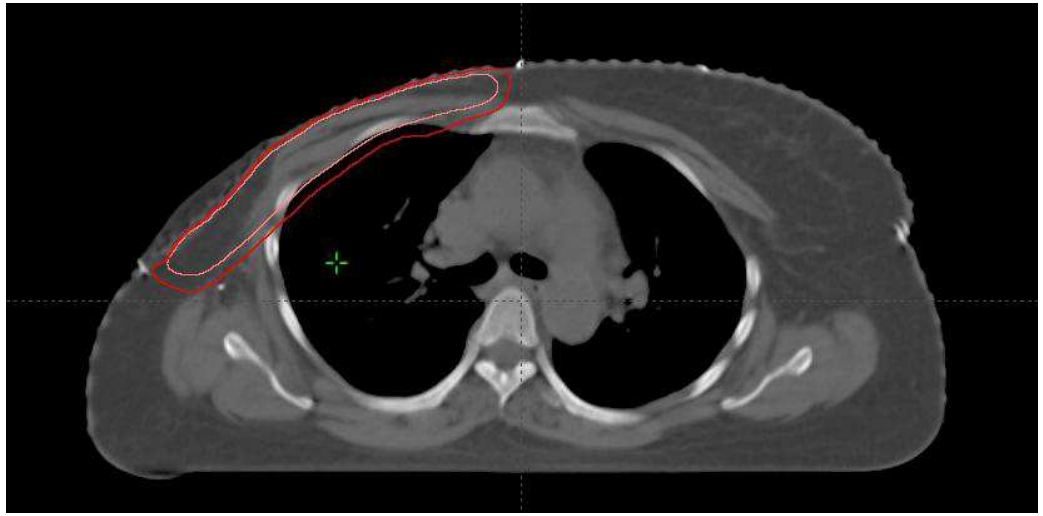
Inflammatory breast cancer- Up to skin

Bolus for all fractions









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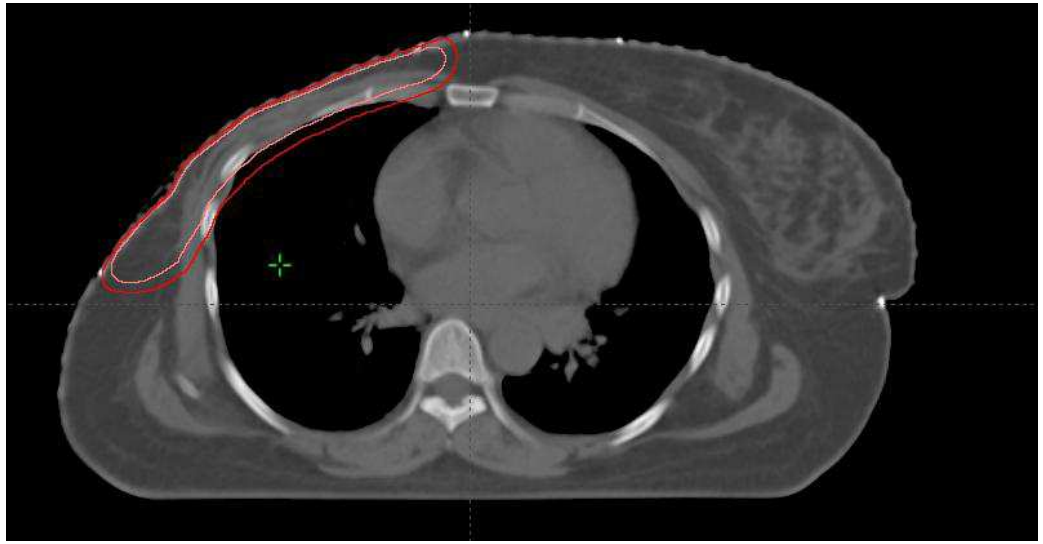
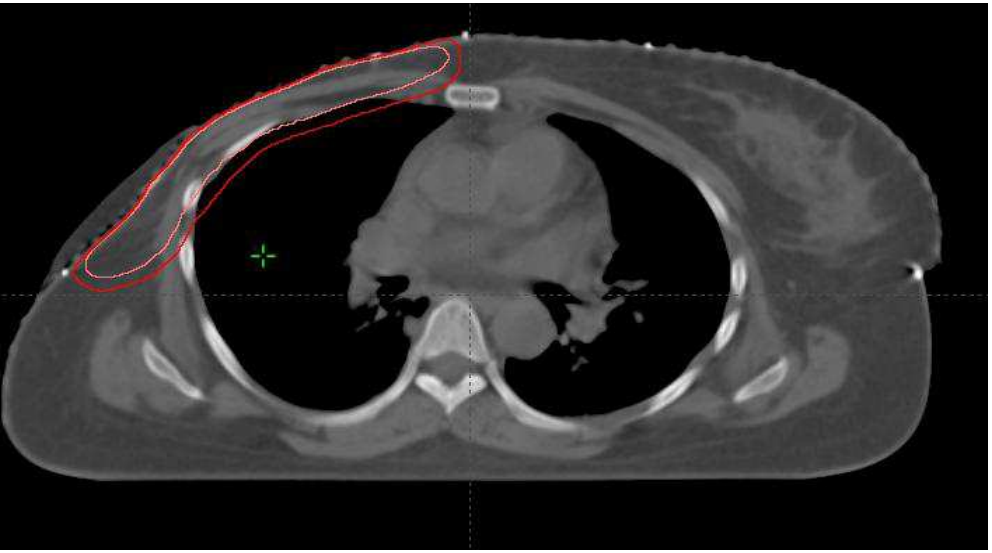




NODAL CONTOURING

Vessel based delineation guidelines for the elective lymph node regions in breast cancer radiation therapy – PROCAB guidelines

Karolien Verhoeven [a,*], Caroline Weltens [a], Vincent Remouchamps [b], Khalil Mahjoubi [b], Liv Veldeman [c], Benoit Lengele [d], Eszter Hortobagyi [a], Carine Kirkove [d]

[a] University Hospitals Leuven/KU Leuven; [b] Clinique Sainte Elisabeth (AMPR), Namur; [c] Ghent University Hospital; and [d] Catholic University of Louvain, Brussels, Belgium

National project to improve quality of Breast Radiation Therapy , PROCAB (PROject on CAncer of the Breast)

Supra (Infra + Retroclavicular+ Periclavicular) LN

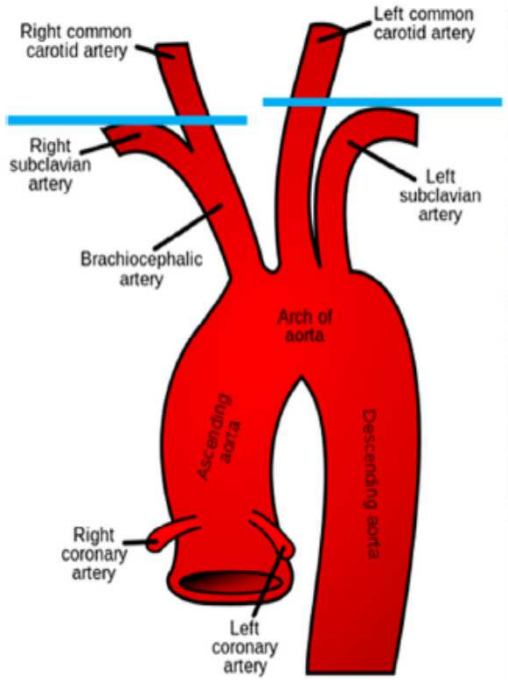
ranial-

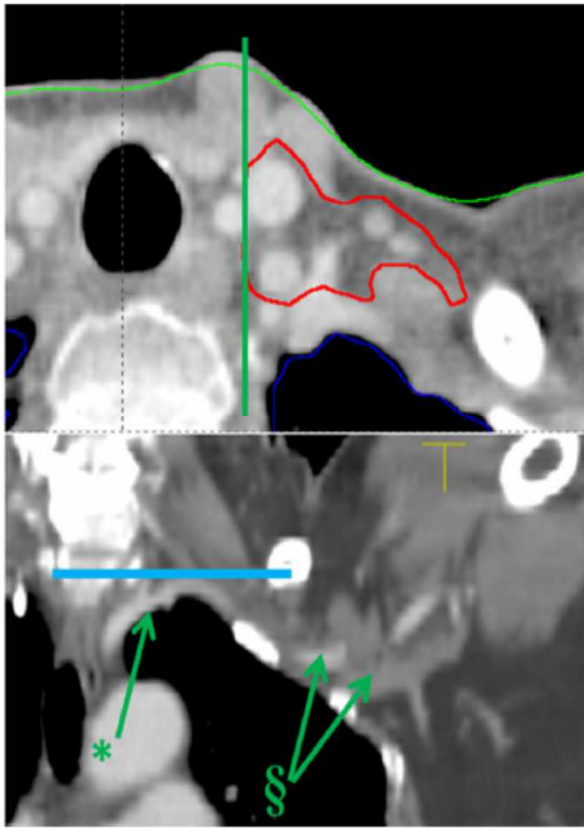
TOG -Caudal Edge Cricoid artilage

ROCAB -Cranial Edge of ubclavian A Arch

f LABC, up to level of transverse ervical vessels

ower Border of Cricoid artilage (MS)

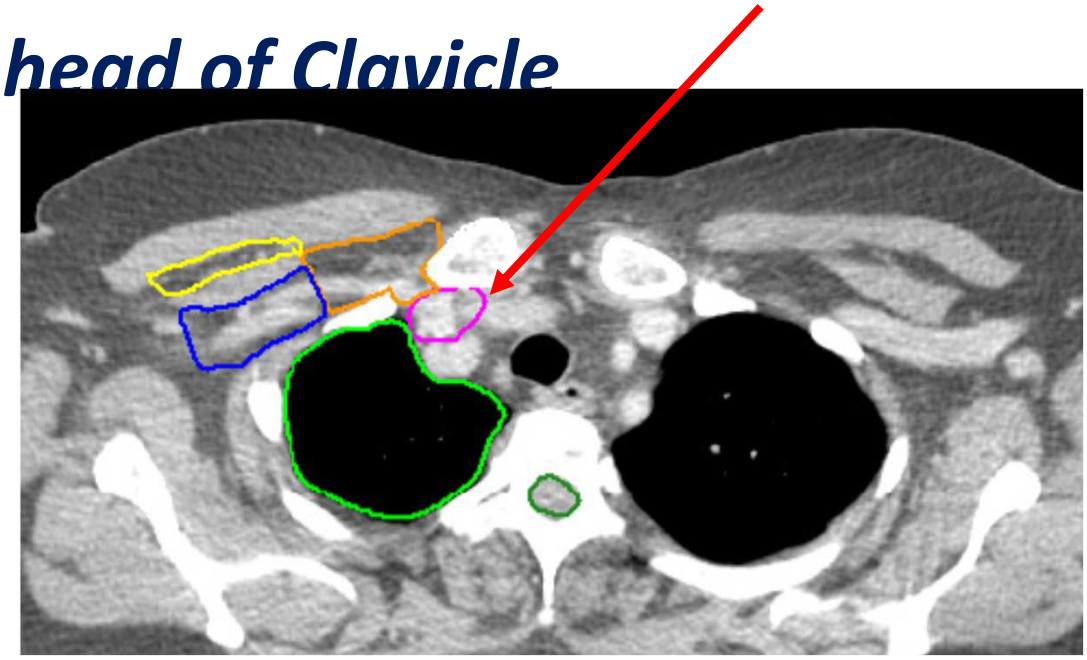




Caudal

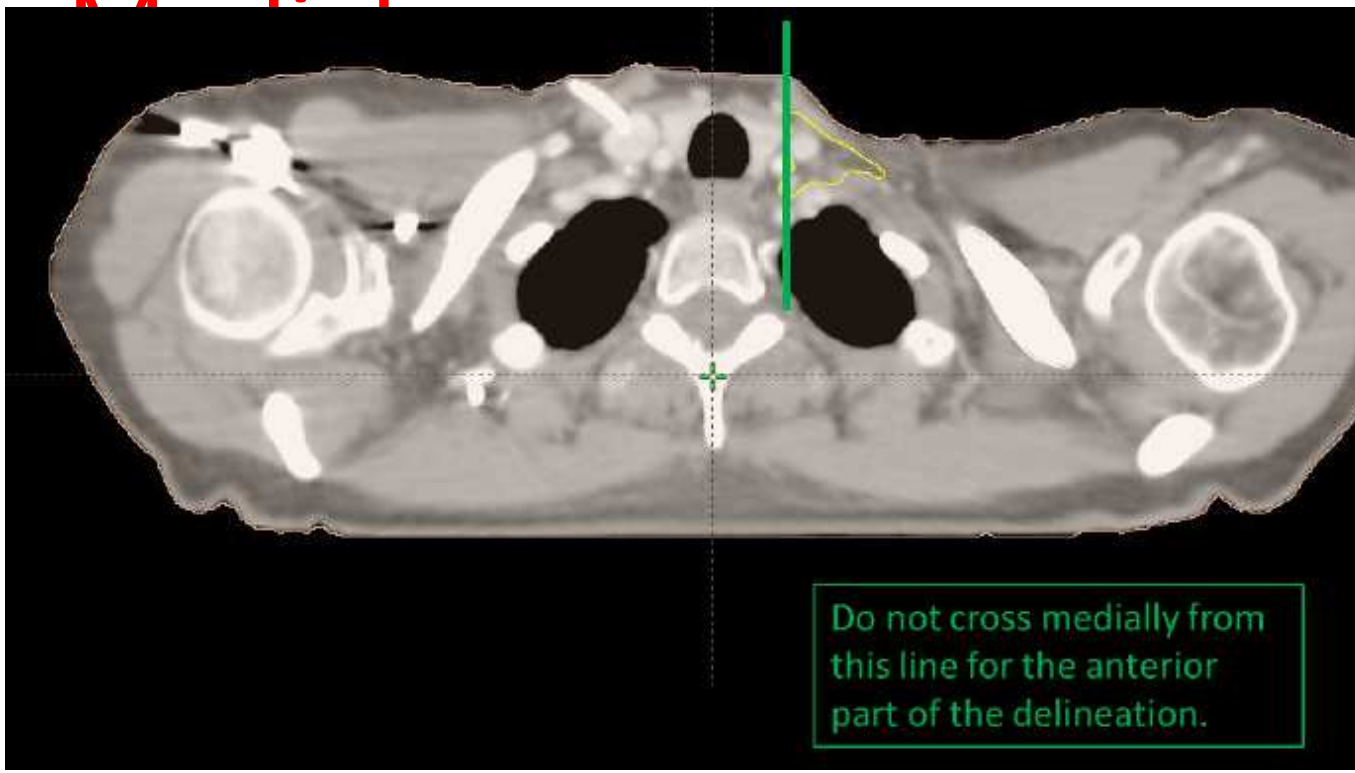
- RTOG-caudal edge of Clavicle
- Junction of Brachiocephalic V and Axillary V

- ***MS- Lower border of medial head of Clavicle***



Exclude thyroid and trachea

Medial Edge of Int carotid A and IJV



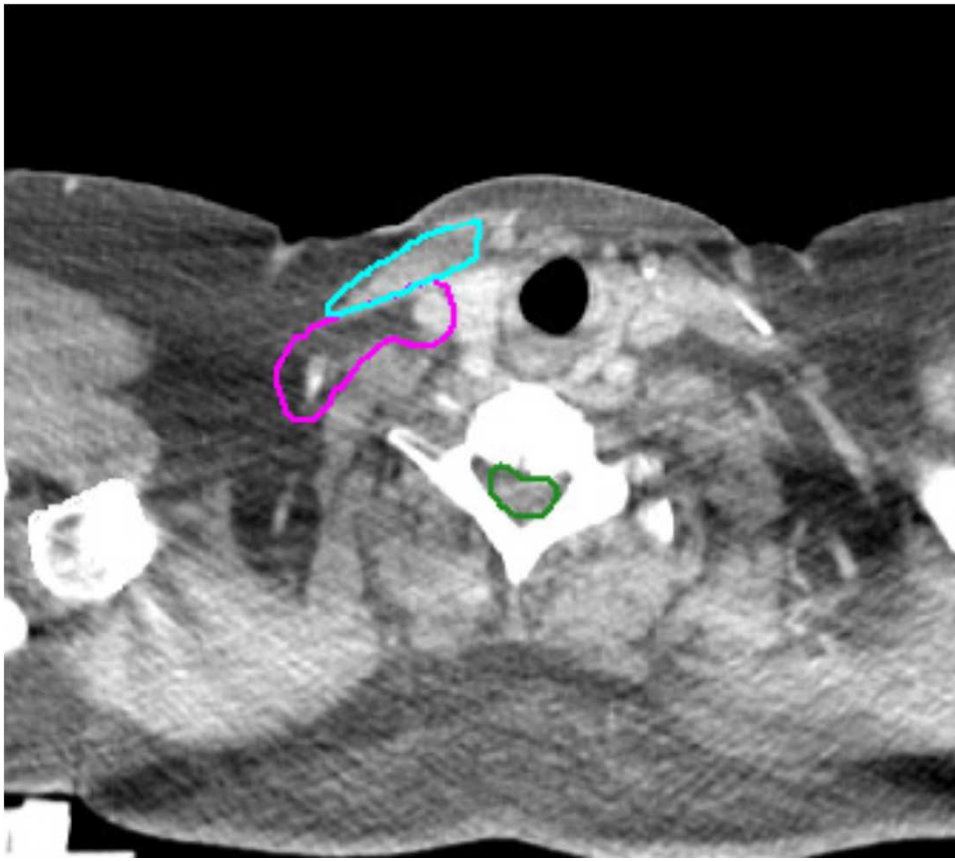
PROCAB

Lateral

- RTOG- Cranially- Scalene ms

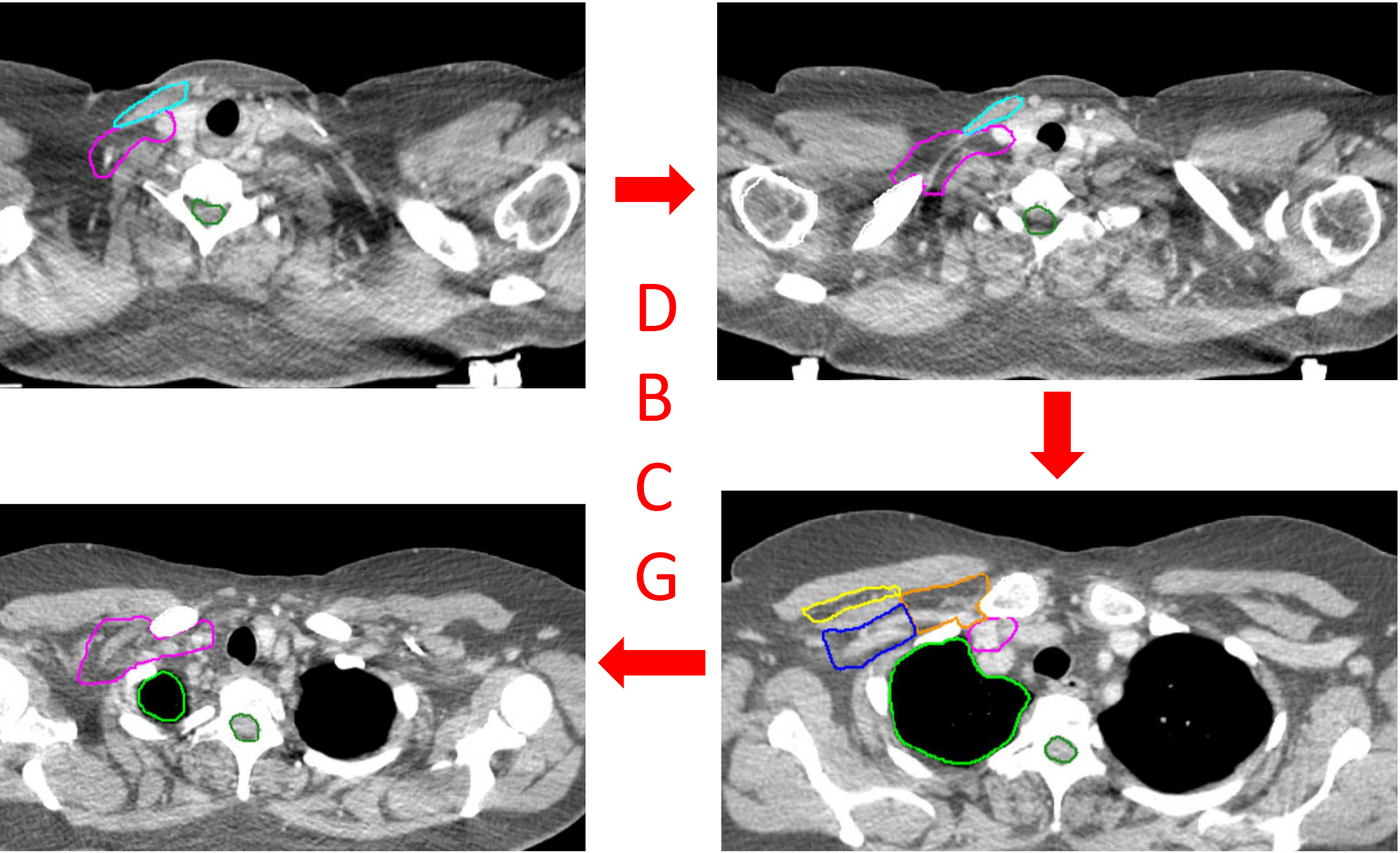
  Caudally- Junction of first rib and clavicle

- DBCG- Medial edge of P Minor and Clavicle



Ventral

- Ventral- SCM, Clavicle, 5 mm below skin
- Dorsal- Cranially- Posterior to ICA and Anterior to scalene medius ms
- Caudally- Lung


D
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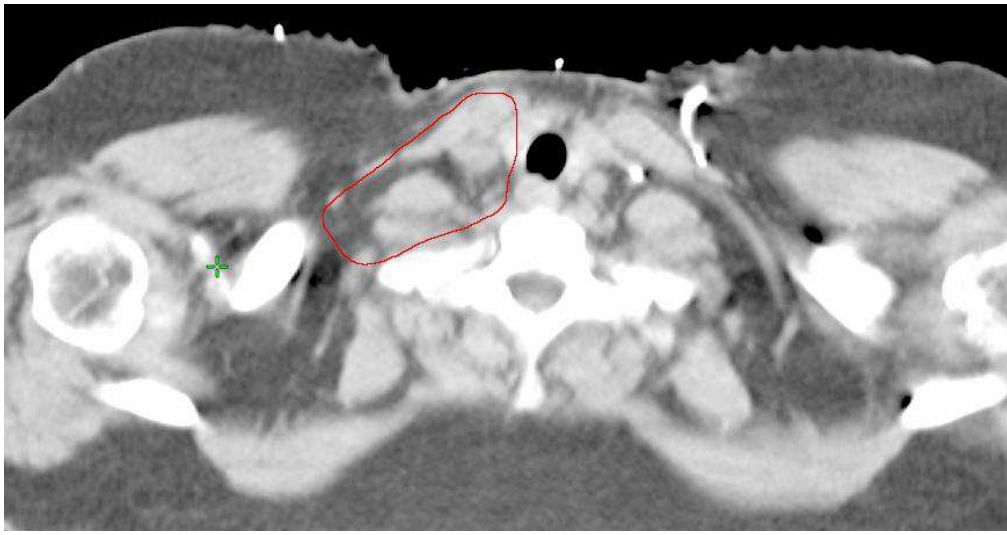

M
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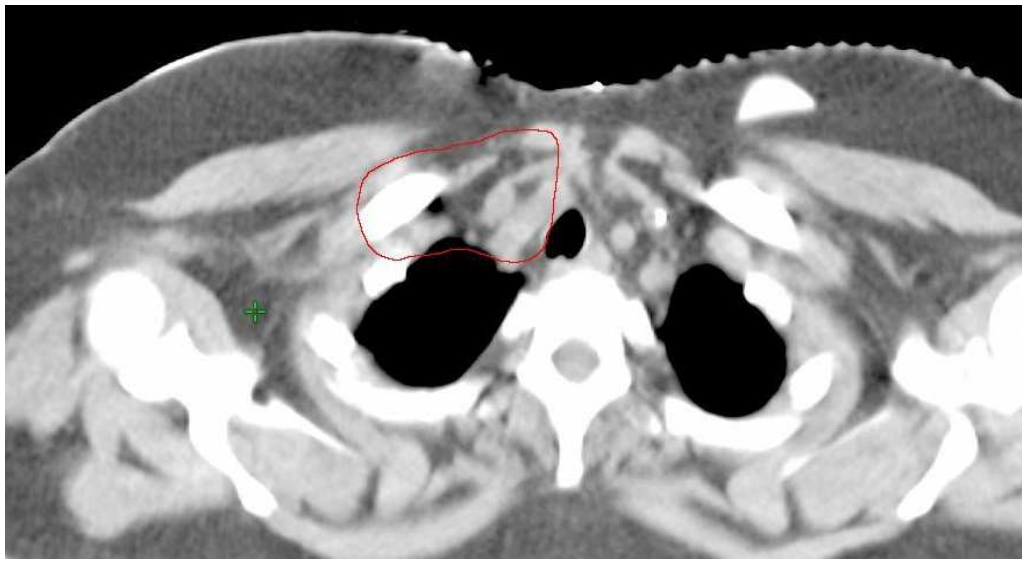

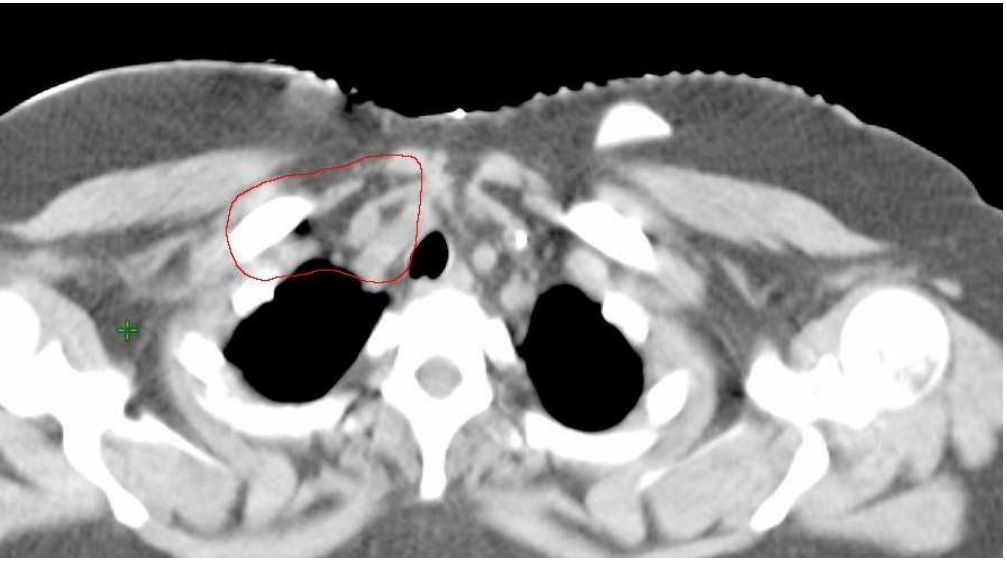

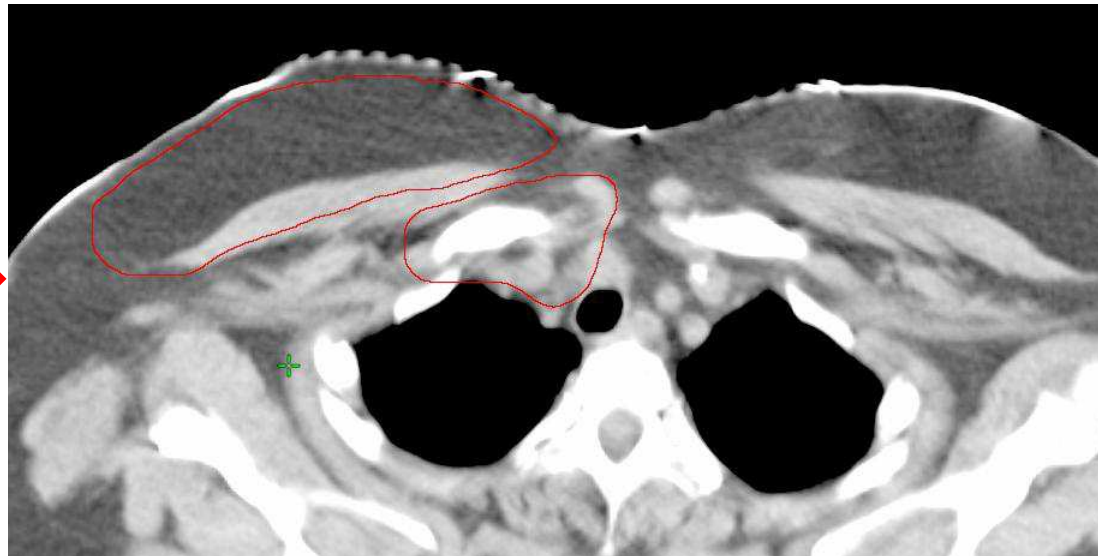

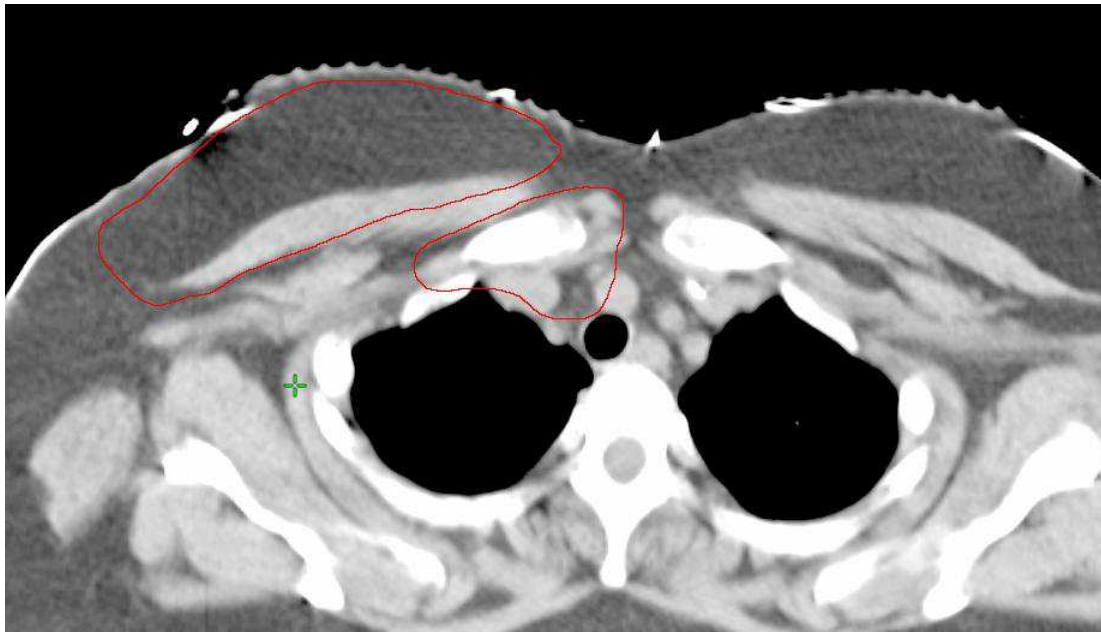

MS

Delineation of Supraclavicular Target Volumes in Breast Cancer Radiation Therapy

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Judy C. Boughey, MD,‡ Stephanie K. Childs, MD,*
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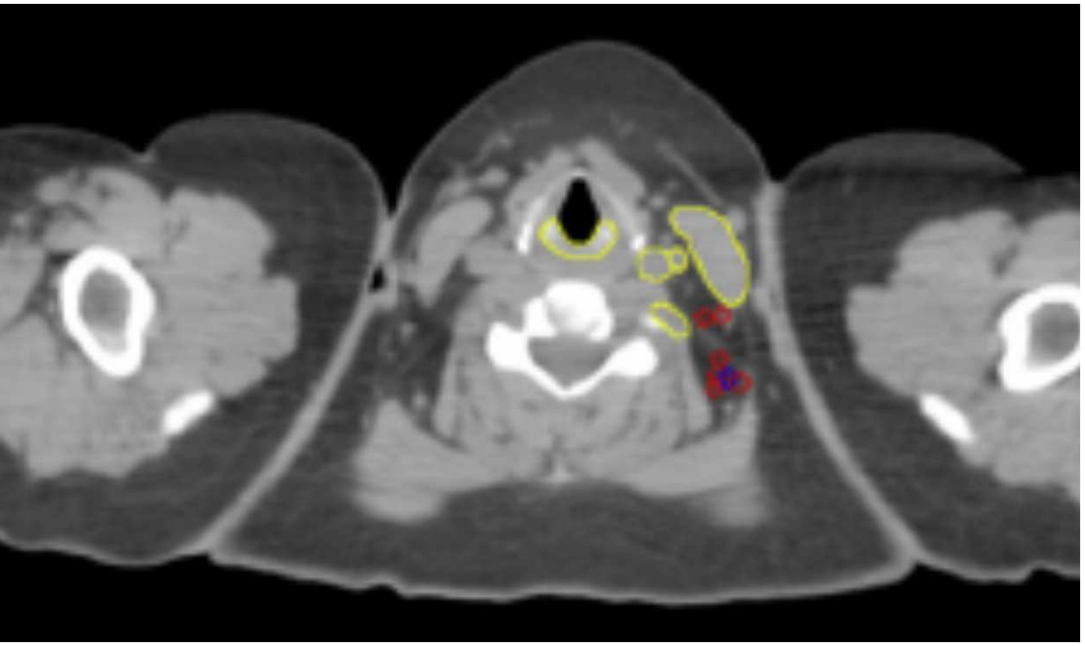
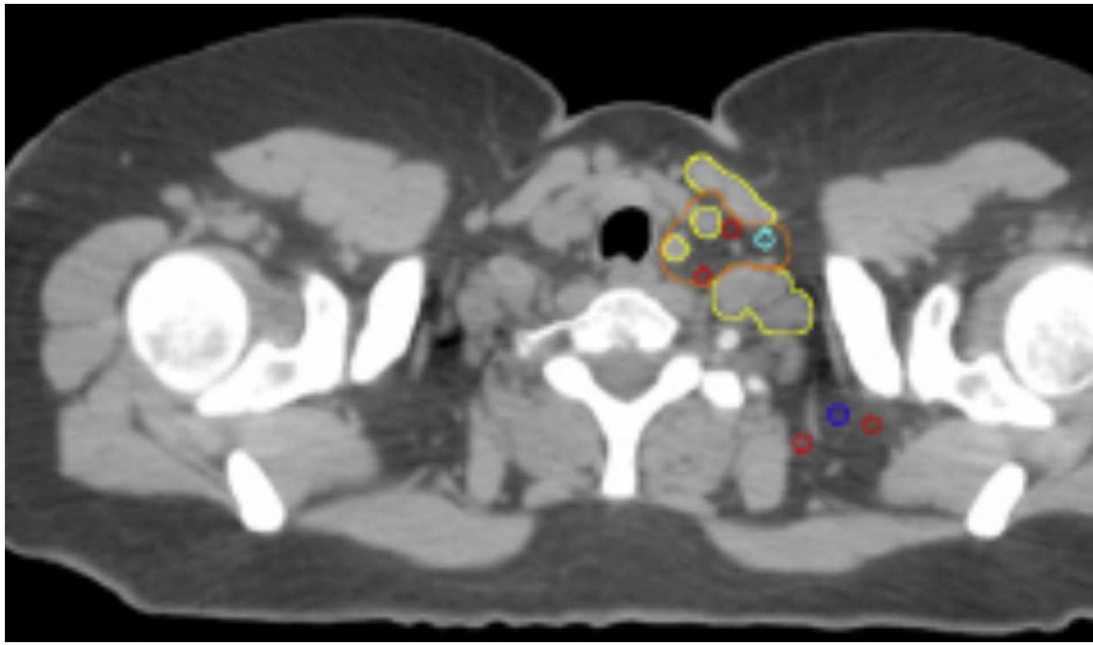
Patterns of SCLNs

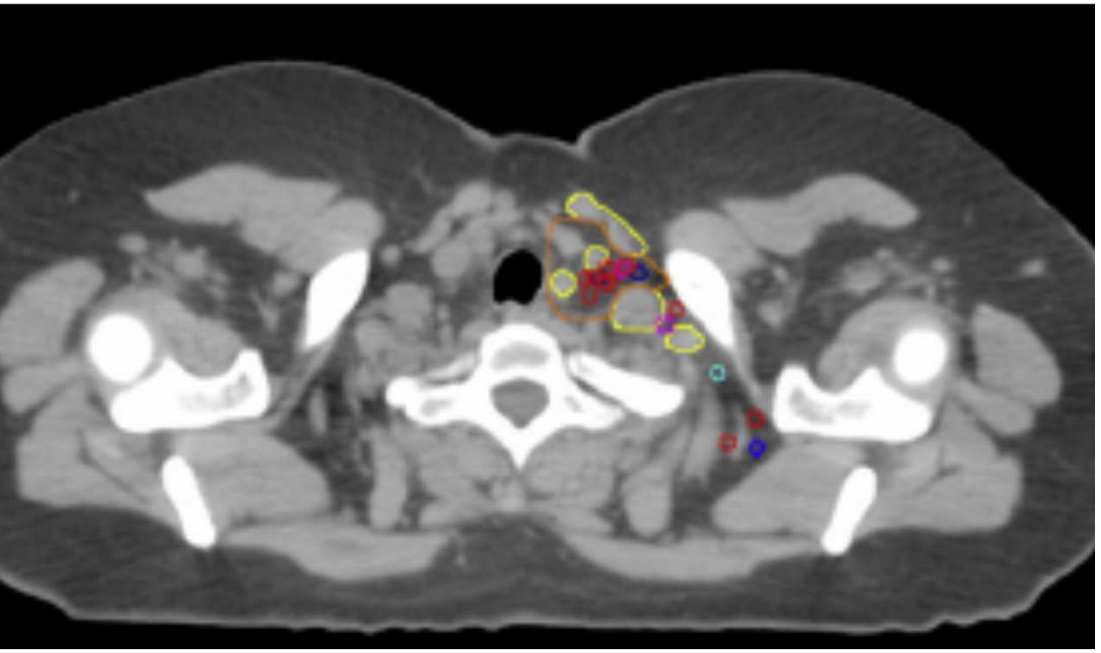
- To map location of gross supraclavicular LNs in patients with breast cancer
- 62 patients with 161 SCLNs (at diagnosis or recurrence) were eligible for this study
- Location of SC LNs were mapped on CT/MR/PETCT
- Location of LNs were then transferred on to axial CT scan of a representative patient with both arms abducted in a typical breast RT position
- All LNs were plotted on left side with a circle of diameter 5mm

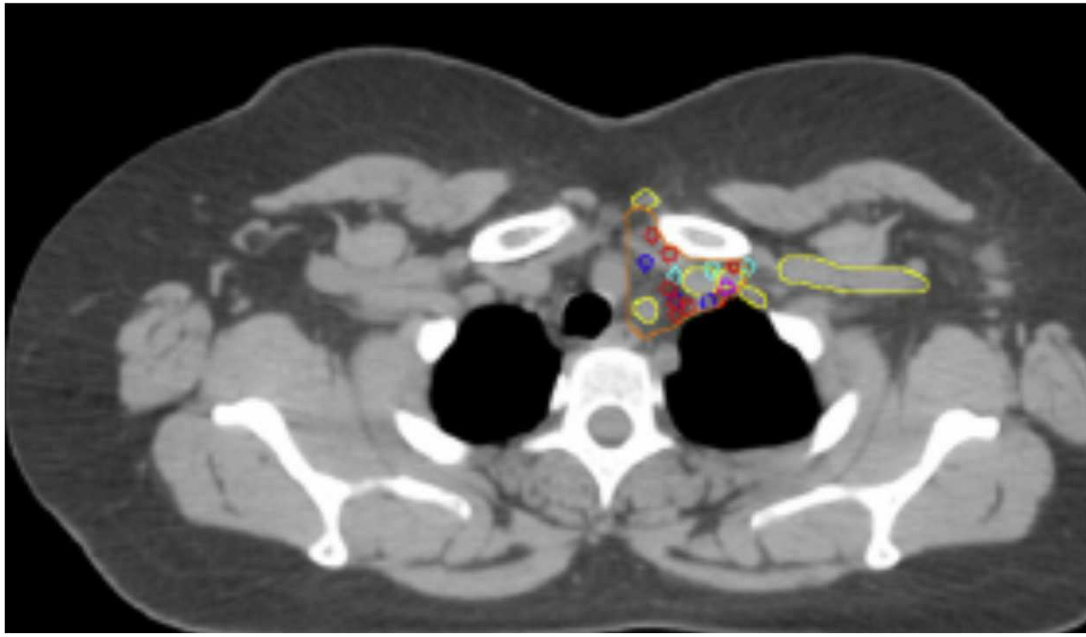
Distribution of LNs at Diagnosis-

- 35- 40% LNs were outside RTOG SCF Volume
- Location of LNs outside RTOG volumes were
- 1. at level of thyroid cartilage- Cranial to RTOG boundaries
- 2. Posterolateral to RTOG volumes in posterior triangle
- 3. Lateral low SCF below level of transverse cervical vessels and lateral to scalene ms or between anterior and middle scalene muscle.
- No recurrences occurred medial to medial border of ICA



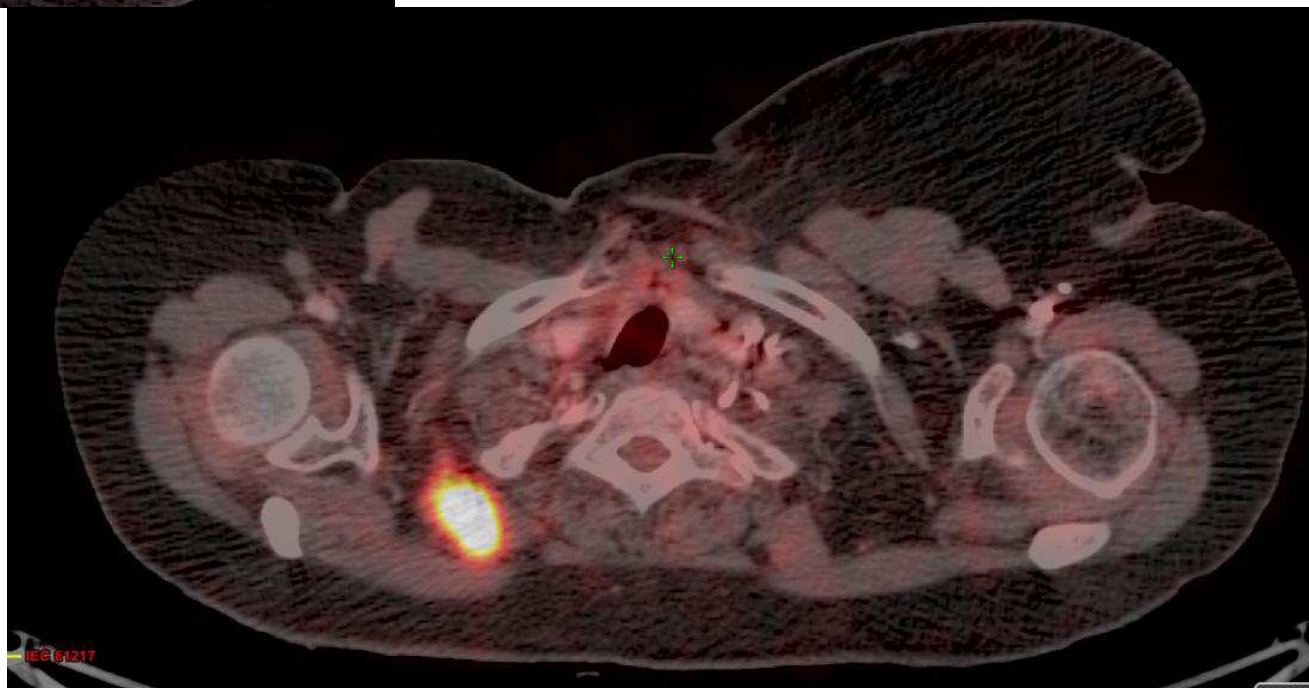




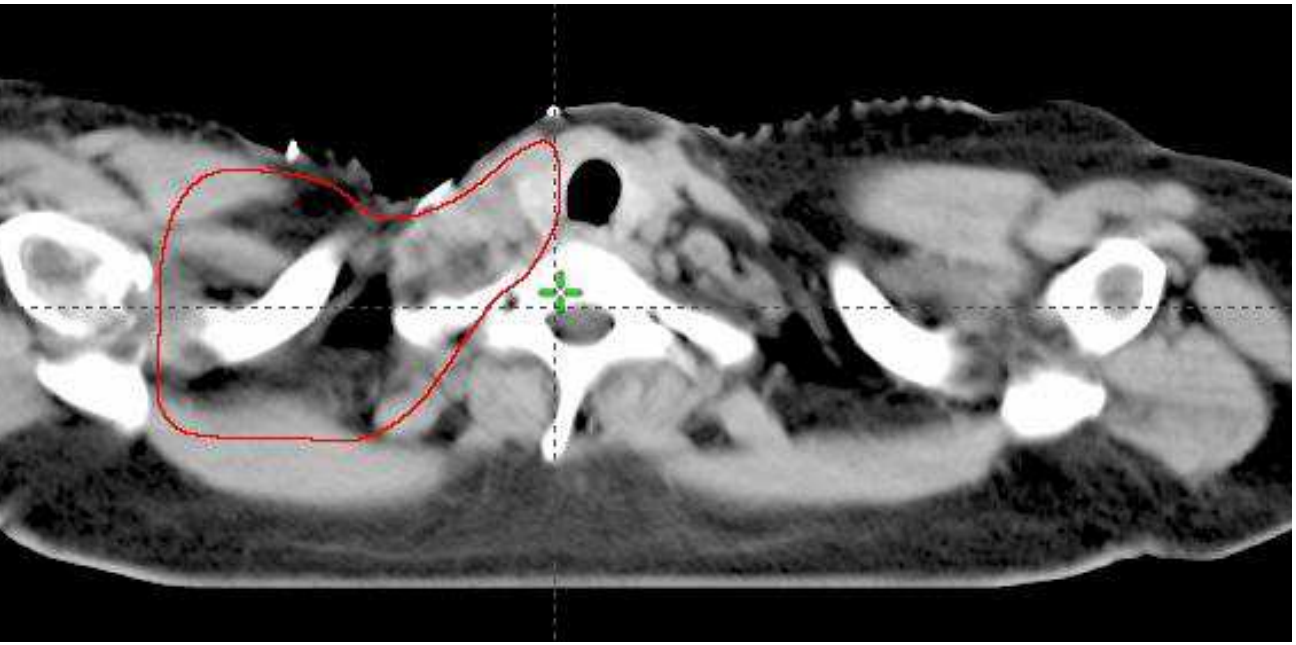


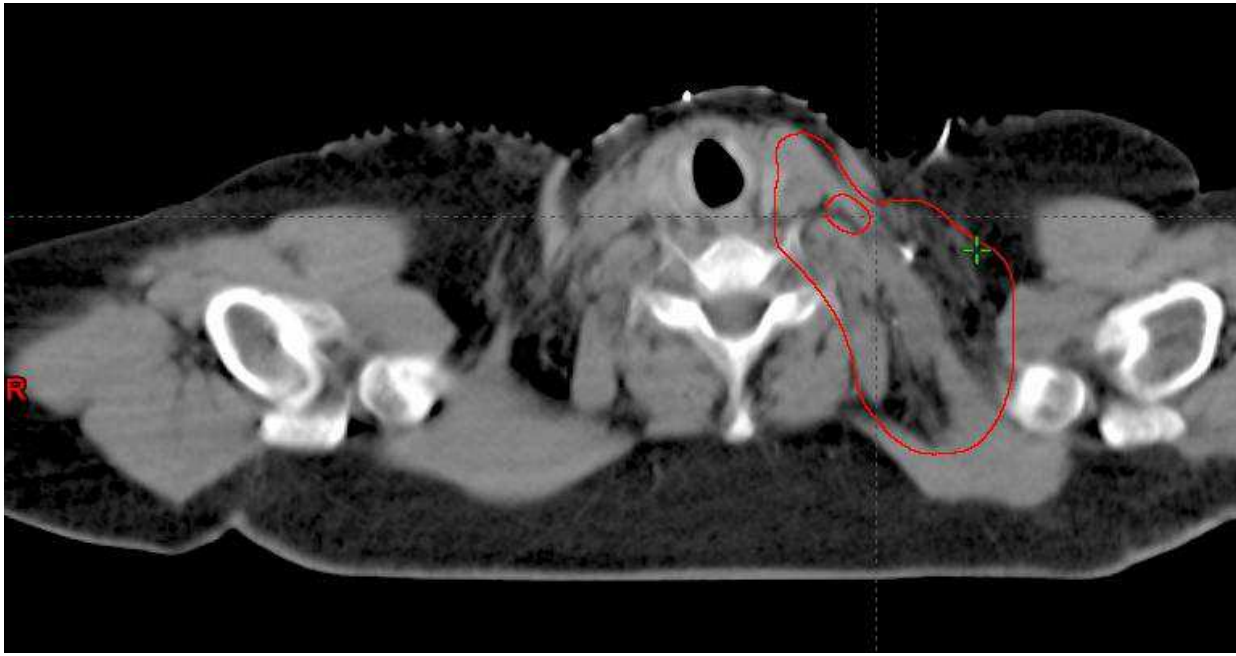
- More generous coverage of SCF in patients with SCLNs at presentation

- Posterior triangle
- Cranial border above cricoid cartilage



PET CT- Laterally and posteriorly located SCLNs– Posterior Triangle





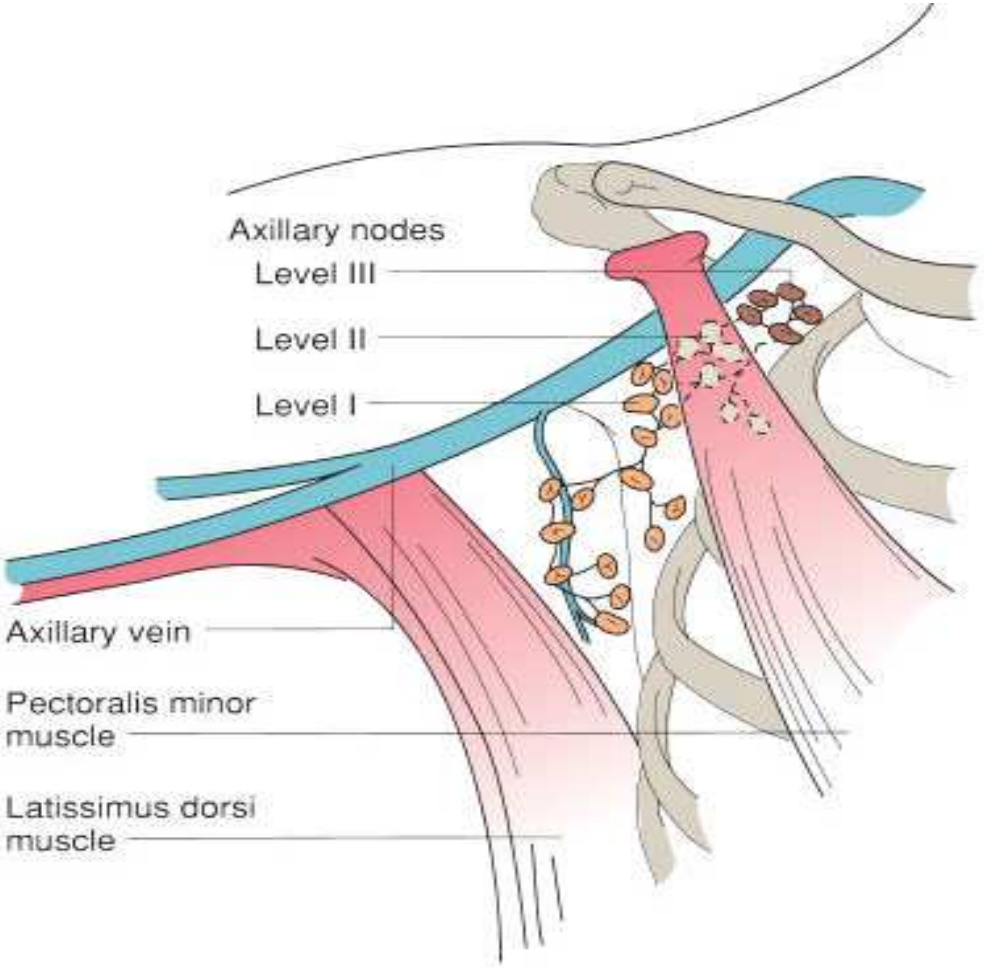
SCF and Posterior Triangle Volumes

Indications of Axillary RT

- Not everyone needs it!

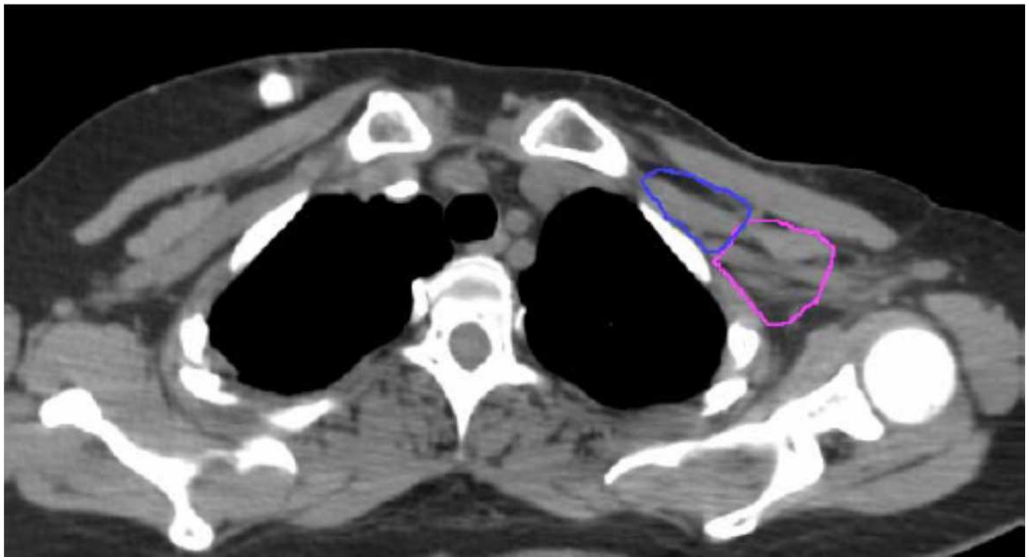
- Heavy Axillary burden with ECE
- Soft tissue deposits present in dissected axillary fat
- Inadequate axillary Dissection
- Positive SLN and AC not done

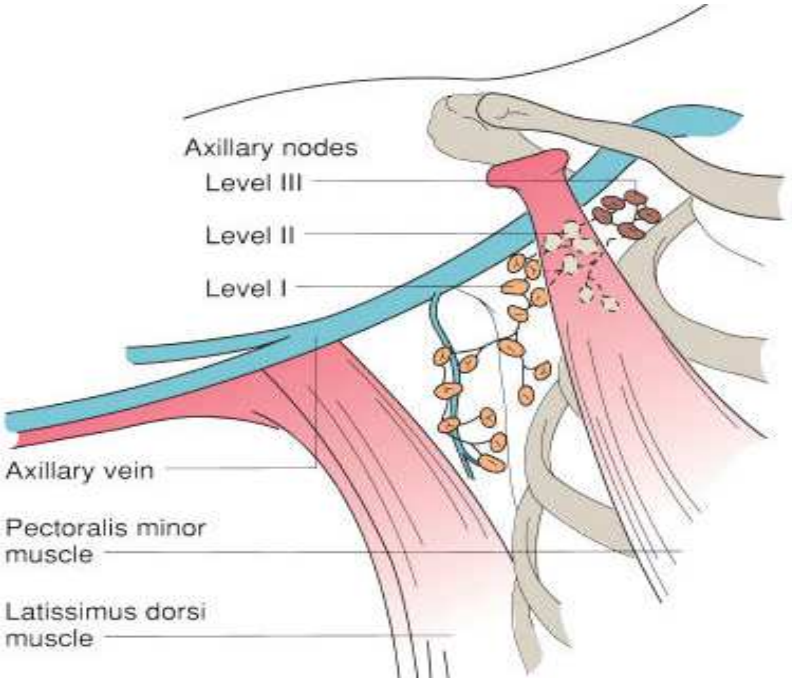
Anatomy of Axilla



Level III Axilla

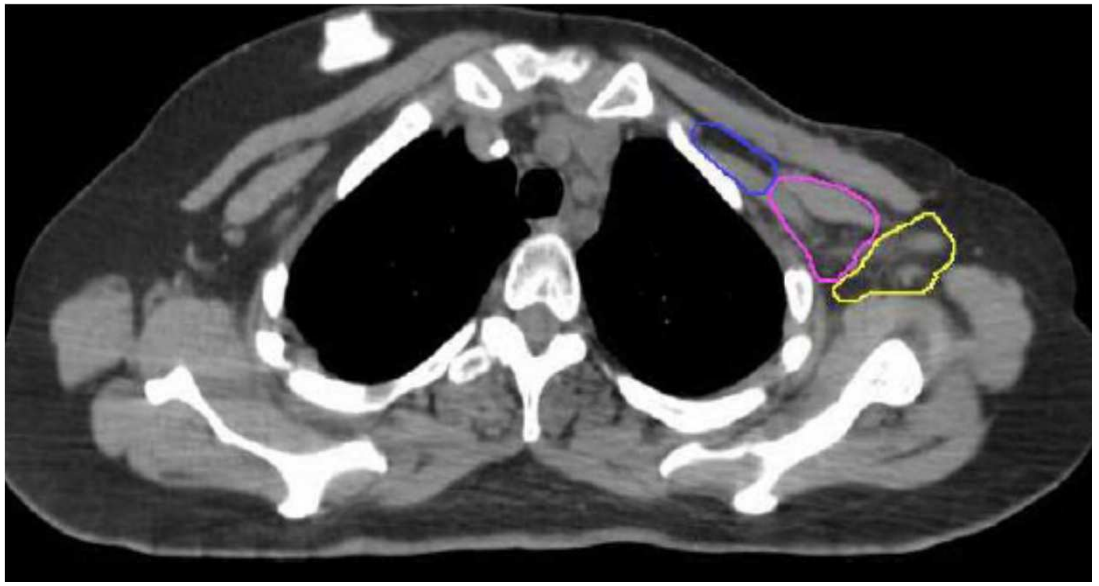
nial	P Minor inserts on Coracoid
dal	Axillary A/V crosses medial edge of P Minor
tral	Dorsal surface of P Major
sal	Ribs and IC Ms
dial	Thoracic Inlet
eral	Medial border of P Minor

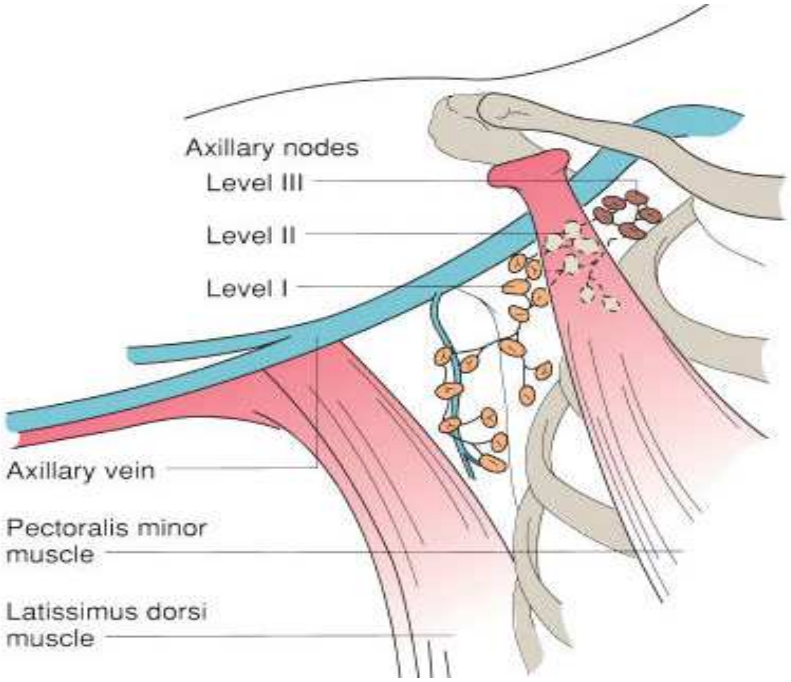




Level II Axilla

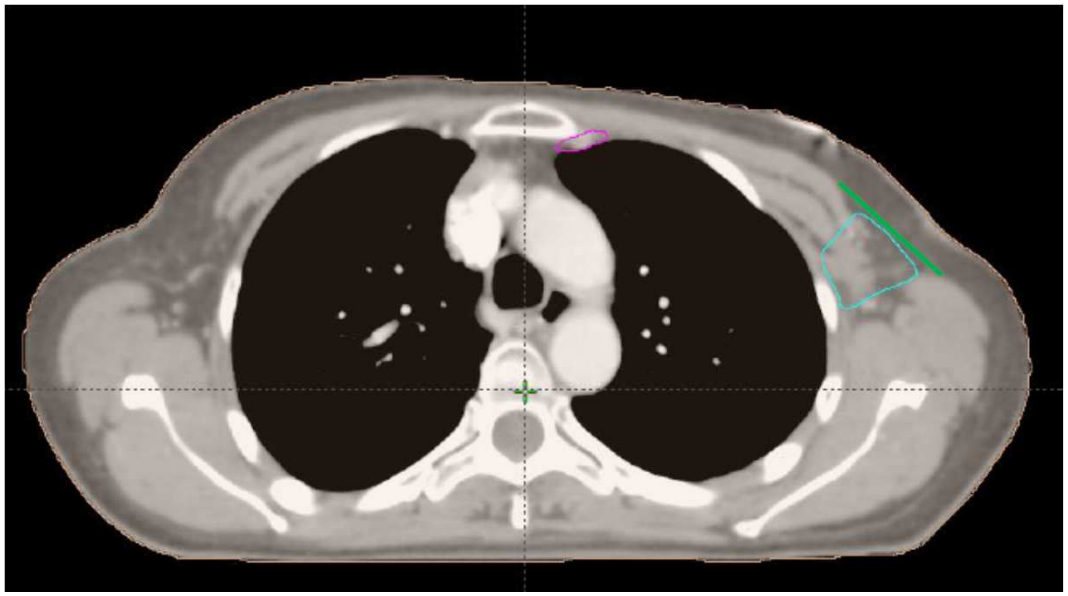
nial	**Axillary A/V crosses medial edge of P Minor**
dal	Axillary A/V crosses lateral edge of P Minor
tral	Anterior surface of P minor
sal	Ribs and IC Ms
dial	Medial border of P Minor
eral	Lateral border of P Minor

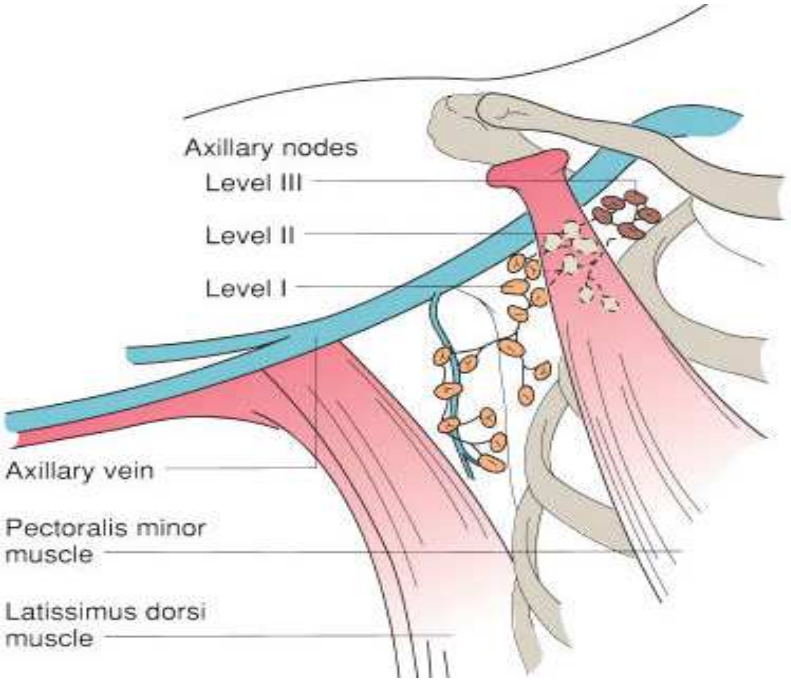




Level I Axilla

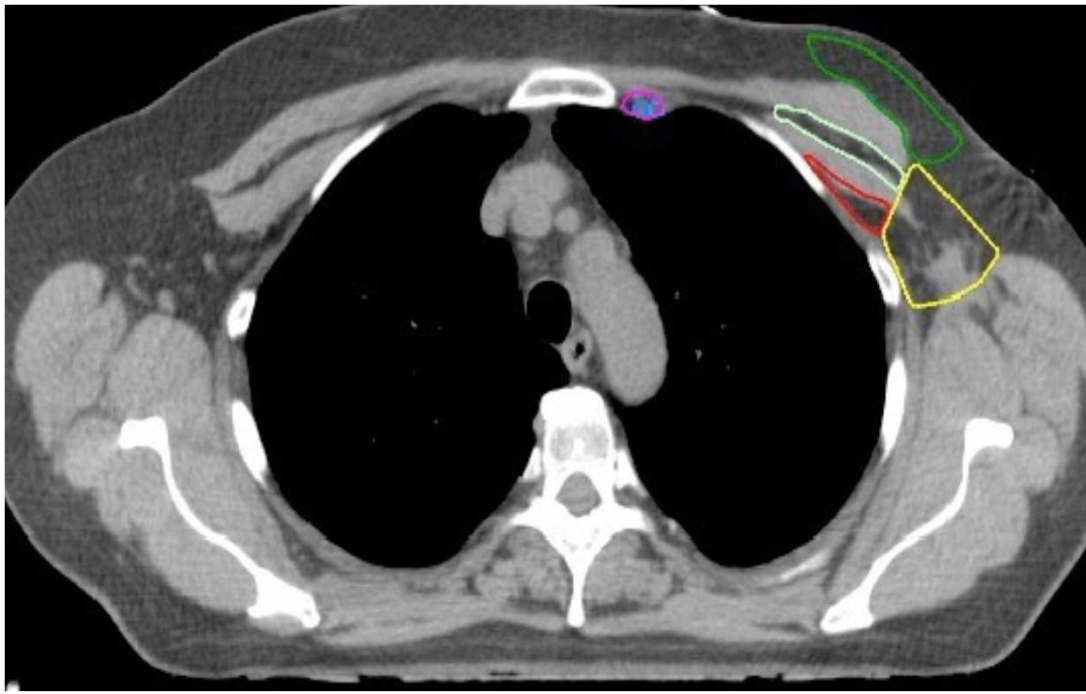
nial	**Axillary A crosses lateral edge of P Minor**
dal	P major inserts into ribs
tral	Plane defined by anterior surface of P major and L Dorsi
sal	Subscapularis
dial	Lateral border of P Minor
eral	Medial border of Lat Dorsi





Interpectoral LNs

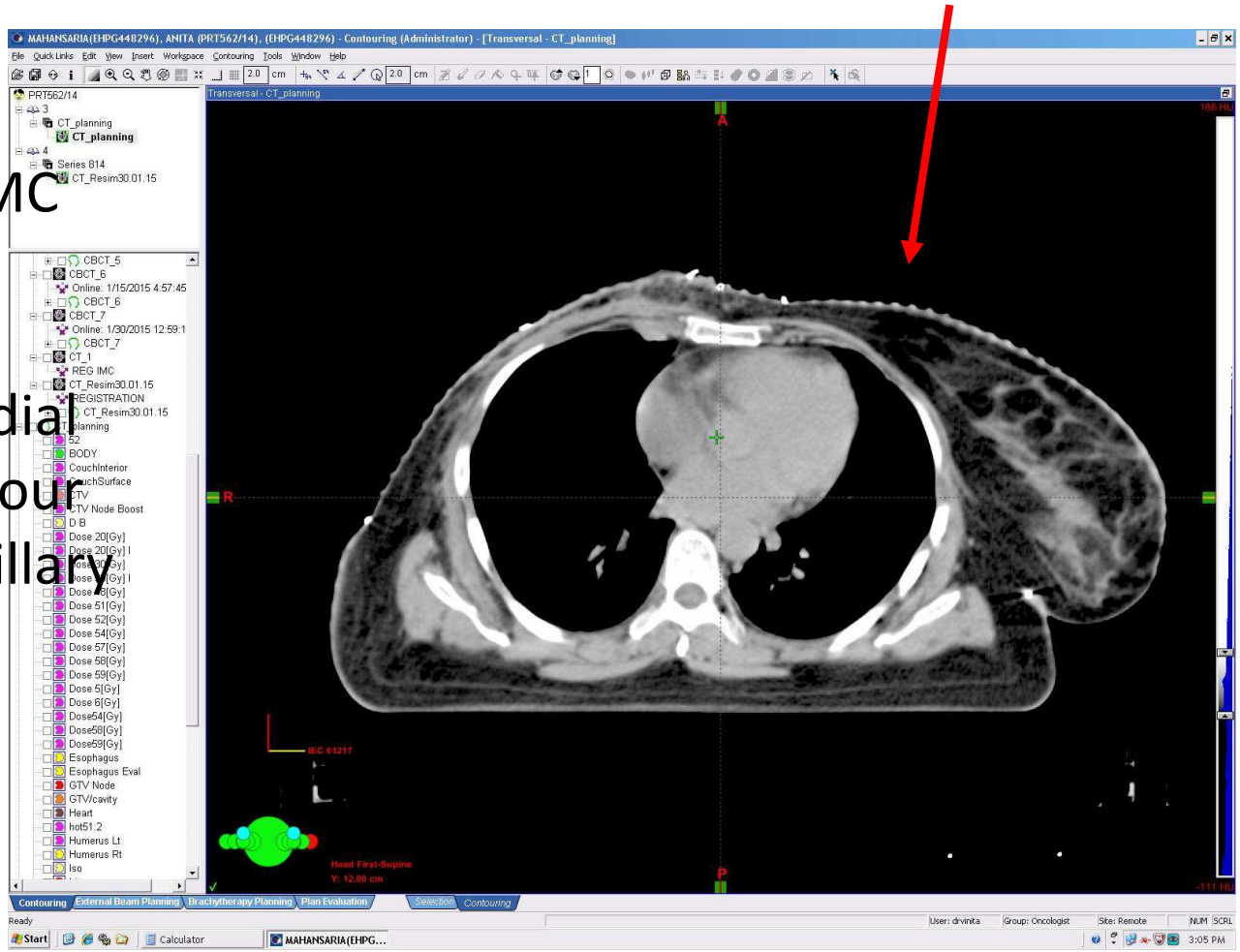
nial	Axillary A crosses medial edge of P Minor
dal	Caudal border of P Minor
tral	Dorsal surface of P major
sal	Ventral surface of P Minor
dial	Medial border of P Minor
eral	Lateral border of P Major



ESTRO

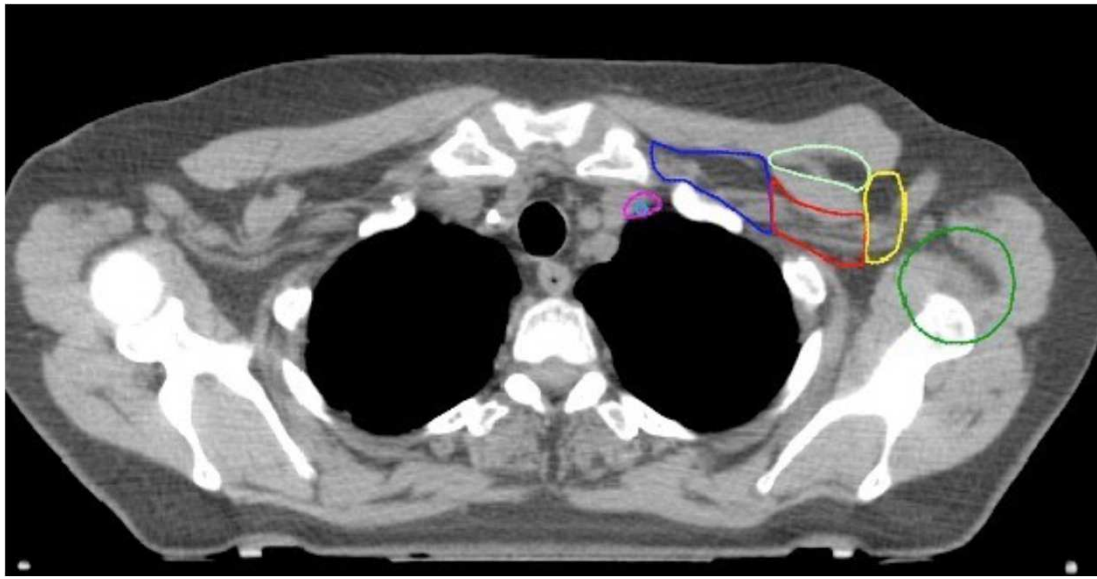
I/C of IMC LN

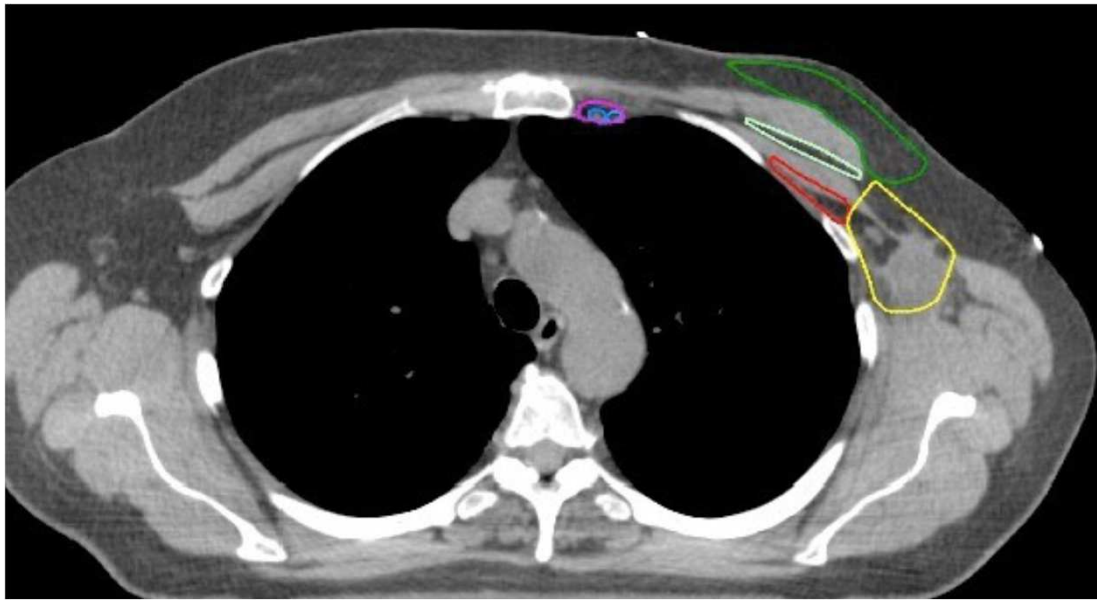
- Presence Of IMC LNs
- Central or Medial Quadrant tumour with Heavy axillary LN positivity



Internal Mammary LNs

nial	**Junction of SCV and Juglar V/ cranial aspect of 1st Rib (and Caudal border of SCF)**
dal	Cranial aspect of 4th Rib
tral	Cranially- Manubrium Sterni Caudally- Dorsal surface of IC Ms
sal	5 mm space dorsal of IM Vessels, not beyond pleura
dial	5 mm space medial of IM Vessels
eral	5 mm space lateral of IM Vessels





OARS

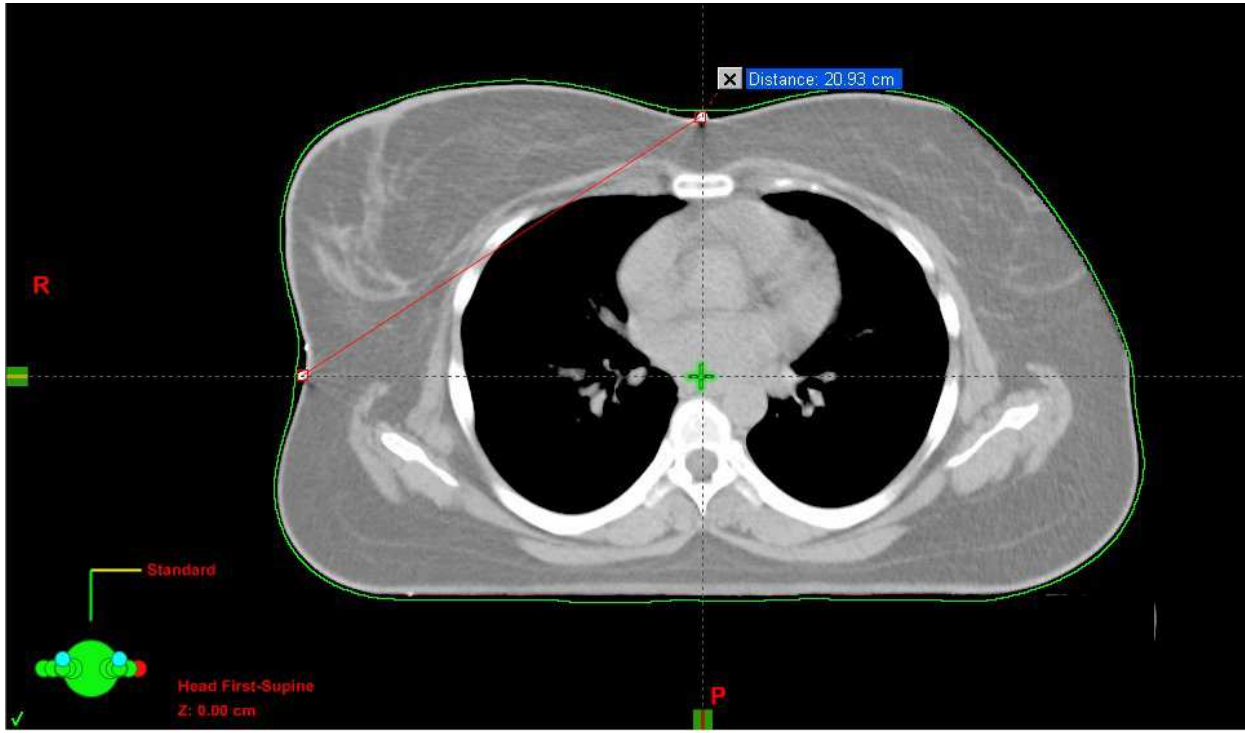
- Heart- Contoured below pulmonary trunk bifurcation
- Coronaries
- All mediastinal tissue below this level should be contoured including great vessels
- I/L and C/L Lungs
- Opposite Breast
- Head of Humerus

- Plan Generation

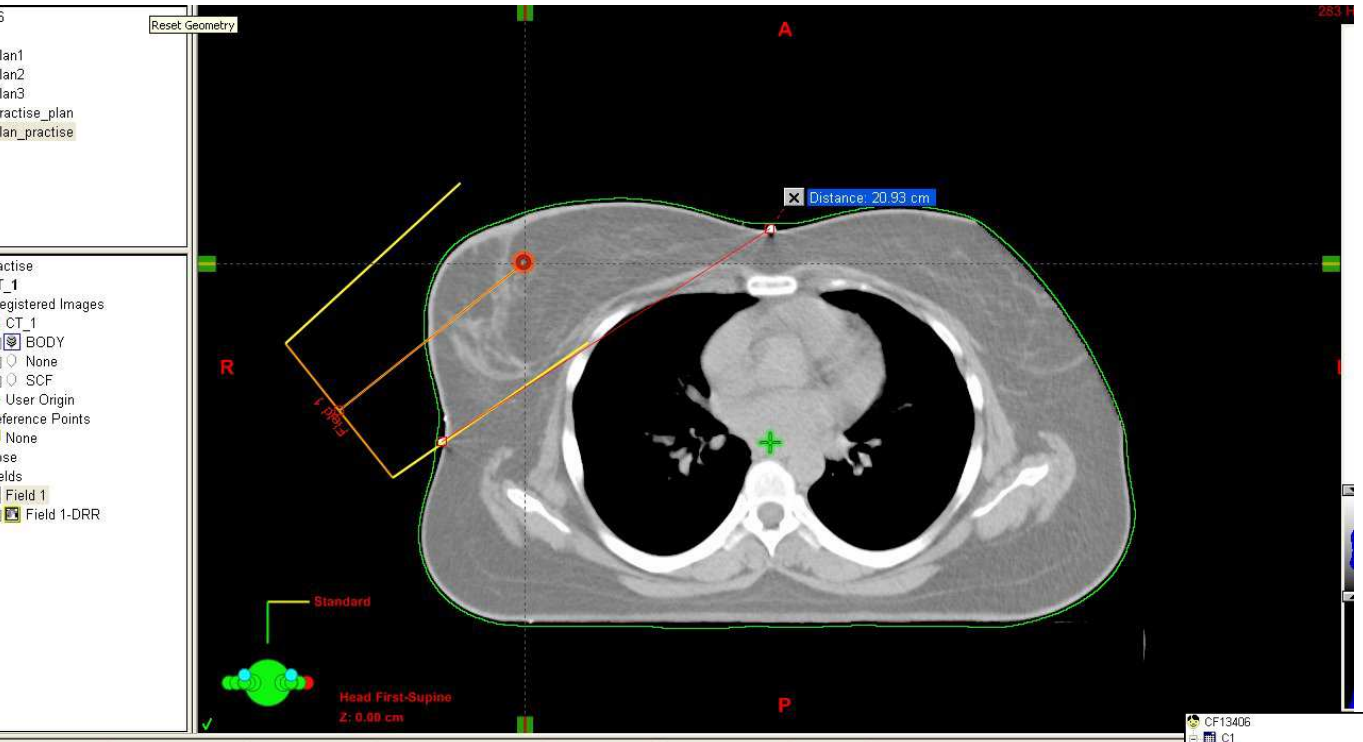
- 3 DCRT
- Forward IMRT- Field in Field
- Hybrid IMRT

Set user origin

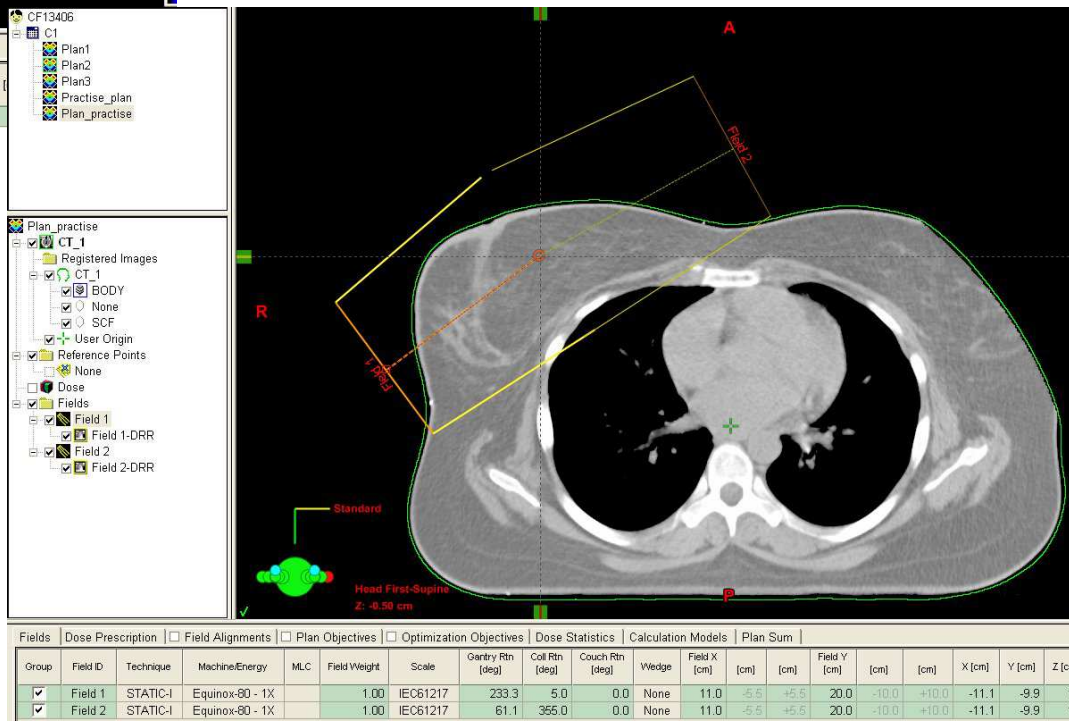
Join medial and lateral markers



Slide Courtesy Dr Ashwini Budrukar



Lateral tangent



Dose Prescription | Field Alignments | Plan Objectives | Optimization Objectives | Dose Statistics | Calculation Models | Plan Sum

Field ID	Technique	Machine/Energy	MLC	Field Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Couch Rtn [deg]	Wedge	Field X [cm]	[cm]	[cm]	Field Y [cm]	[cm]	[cm]	X [cm]	Y [cm]	Z [
Field 1	STATIC-I	Equinox-80 - 1X		1.00	IEC61217	231.4	0.0	0.0	None	11.0	-5.5	+5.5	20.0	-10.0	+10.0	-13.3	-9.7	

Fields | Dose Prescription | Field Alignments | Plan Objectives | Optimization Objectives | Dose Statistics | Calculation Models | Plan Sum

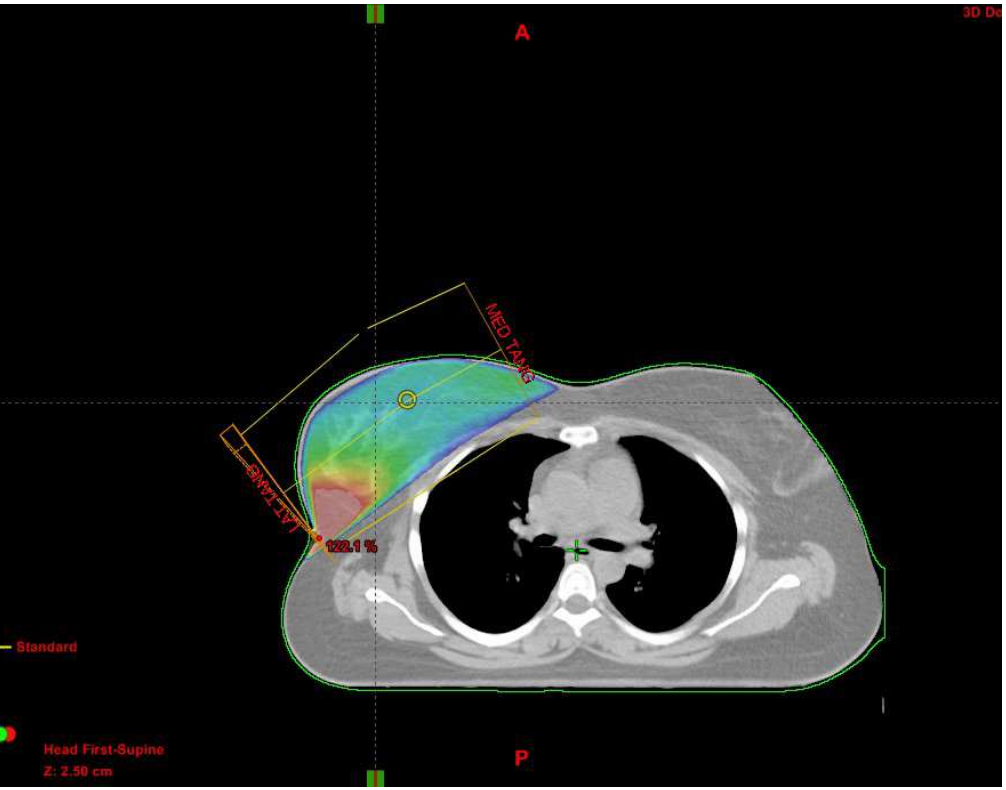
Group	Field ID	Technique	Machine/Energy	MLC	Field Weight	Scale	Gantry Rtn [deg]	Coll Rtn [deg]	Couch Rtn [deg]	Wedge	Field X [cm]	[cm]	[cm]	Field Y [cm]	[cm]	[cm]	X [cm]	Y [cm]	Z [c
☑	Field 1	STATIC-I	Equinox-80 - 1X		1.00	IEC61217	233.3	5.0	0.0	None	11.0	-5.5	+5.5	20.0	-10.0	+10.0	-11.1	-9.9	
☑	Field 2	STATIC-I	Equinox-80 - 1X		1.00	IEC61217	61.1	355.0	0.0	None	11.0	-5.5	+5.5	20.0	-10.0	+10.0	-11.1	-9.9	

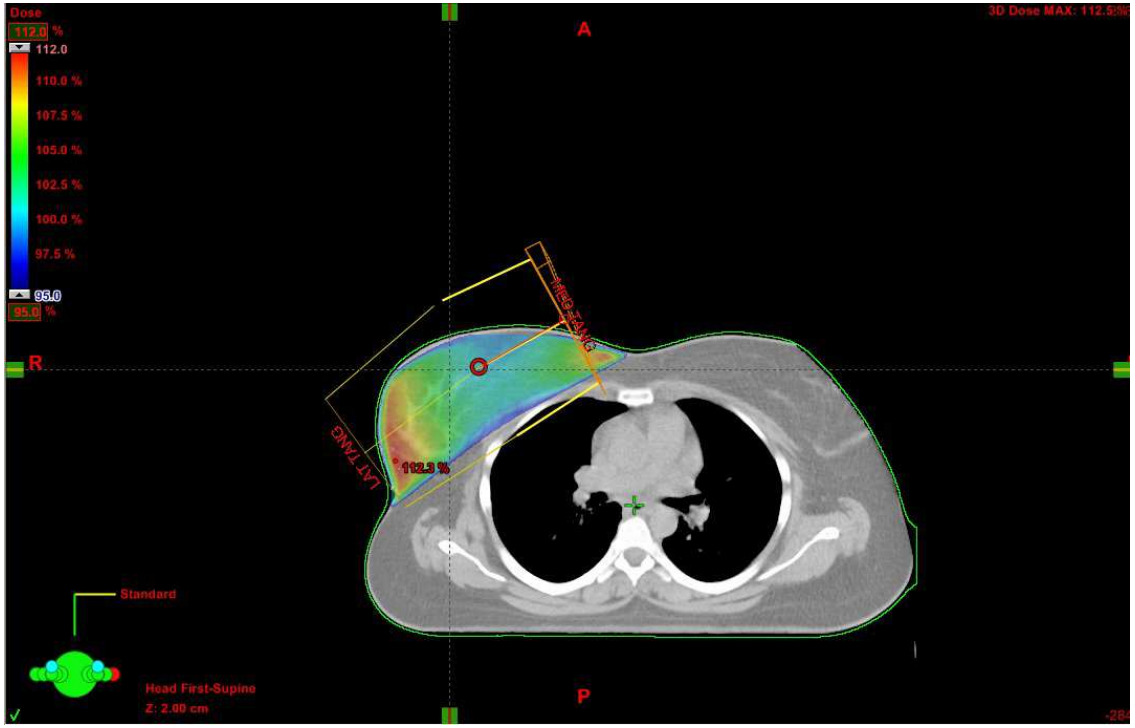
Slide Courtesy Dr Ashwini Budrukar

COBALT -2 field, no wedge

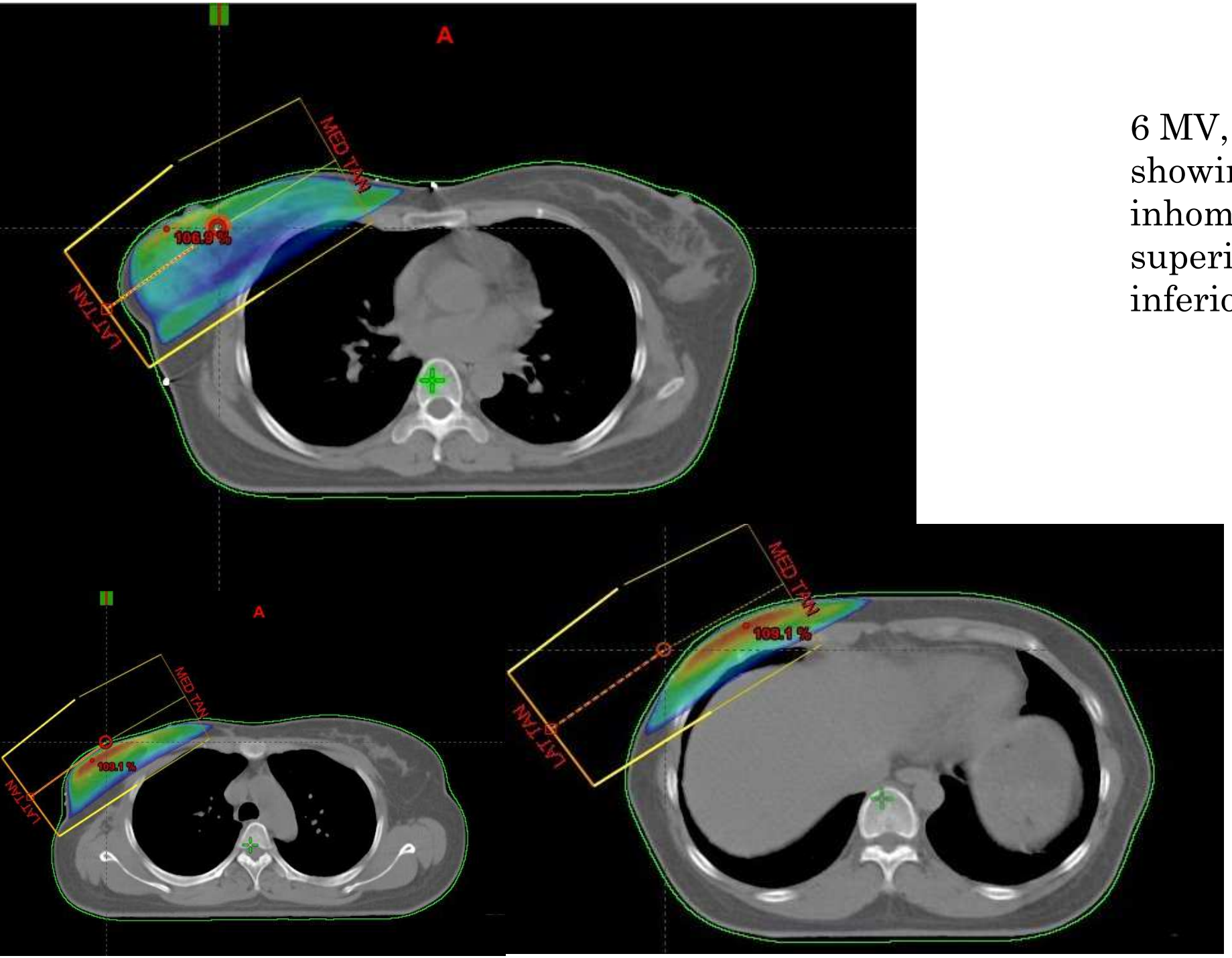
Slide Courtesy Dr Ashwini Budrukar

BAD PLANS
COBALT with WEDGE



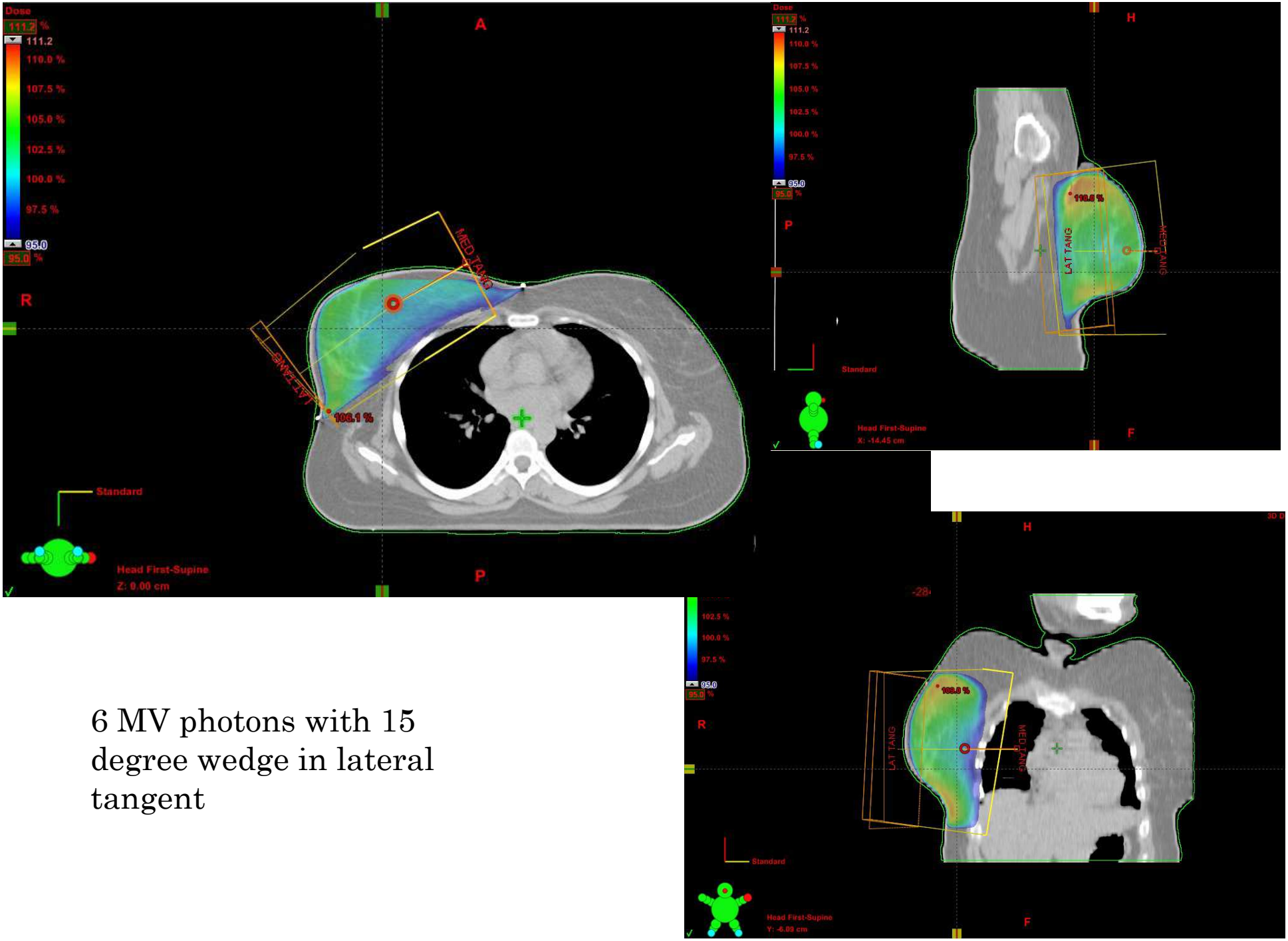


Slide Courtesy Dr Ashwini Budrukar



6 MV, 2-field showing dose inhomogeneity superiorly and inferiorly

Slide Courtesy
Ashwini
Budrukar



6 MV photons with 15 degree wedge in lateral tangent

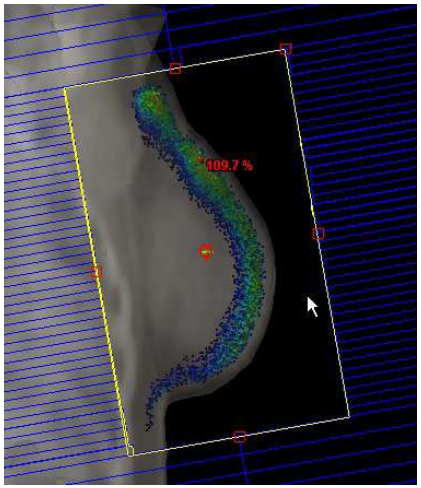
Forward IMRT

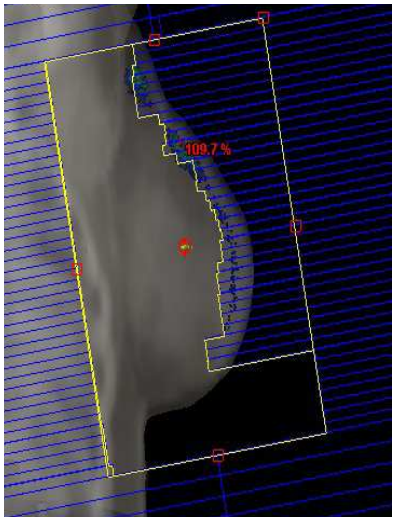
Field-in-field technique:

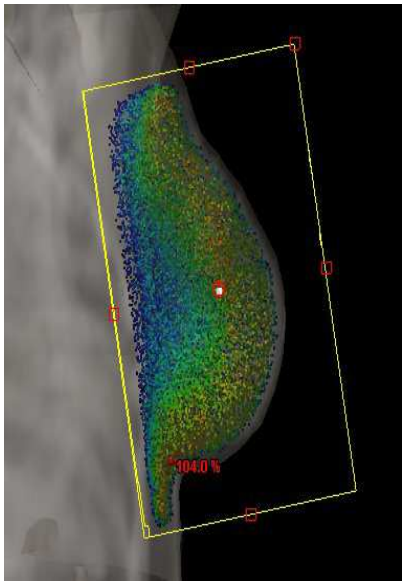
- Medial and lateral tangents are first planned and dose distribution noted.
- Areas of high dose are then contoured/delineated.
- A new field is created within the existing tangential field with an appropriate MLC configuration so as to reduce the inhomogeneity in these areas.

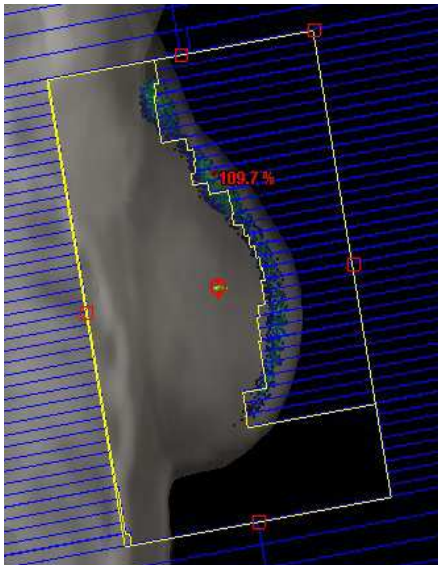
- These fields are finally fused by the treatment planning system.

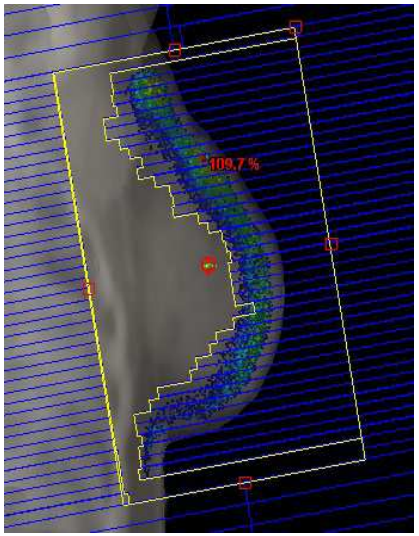
Forward Planned IMRT





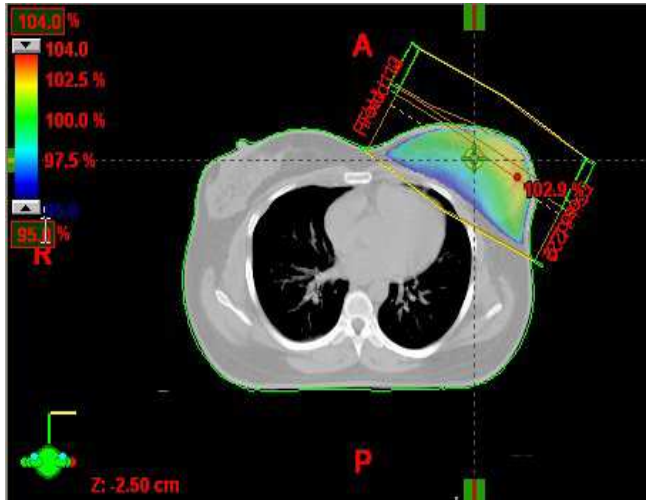






Multiple subfields in each tangent

All the subfields merged to form dynamic MLC motion



Hybrid IMRT

- Add Bilateral open Tangential fields
- Add Bilateral IMRT Tangential Fields to reduce dose inhomogeneity and reduce high doses to ipsilateral lung and heart

DVH

- Evaluate both CTV and PTV –

PTV	Ideal	Acceptable
D95%	95%	
D90%		90%
Dmax	< 115%	<120%

OAR Doses

C/L Breast D max	<3Gy
I/L Lung V 20Gy	<15 -20%
I/L Lung V 10Gy	<35 -40%
I/L Lung V 5Gy	<50 -55%
C/L Lung V5 Gy	<10% -15%
Heart (Left Breast Cancer) V20Gy	<10%
Heart (Left Breast Cancer) V10Gy	<30%
Heart (Right Breast Cancer) V20Gy	0%
Heart (Right Breast Cancer) V10Gy	<10 -15%
Mean	<4 -5Gy

OAR Doses -HF

	CF	HF
/L Lung	V 20Gy	V 16Gy
	V 10 Gy	V 8 Gy
	V 5Gy	V 4Gy
Heart	V 25Gy	V 20 Gy
	V 20Gy	V 16Gy

THANKS