Advanced Breast/Chest Wall Planning Challenges

A COMMUNITY BASED HOSPITAL EXPERIENCE

Objectives

- Intro to Corpus Christi Cancer Center
- Contouring
- Normal tissue dosimetric guidelines
- 18 patient case study specifics
- 3D comparisons
- 1 Retrospective replan
- VMAT
- Discussion/Closing

- Intro to Corpus Christi Cancer Center

Equipment

- Elekta Synergy
- Agility MLC
- Monaco 5.11.02
- Hexipod Robotic Couch installed 03/2017
- Mosaiq
- Phillips Big Bore CT
- MIM

Personnel

- 1 Physician
- 1 Physicist
- 1 Dosimetrist
- 3 Therapist
- 1 Nurse
- 2 Medical assistant/Transcription reception
- 1 Administrator

Demographics

- 250-275 New patients per year
  - 30%-35% breasts
- 20%-25% include lymph nodes

Contouring

Contouring

Breast Cancer Atlas for Radiation Therapy Planning:
Consensus Definitions

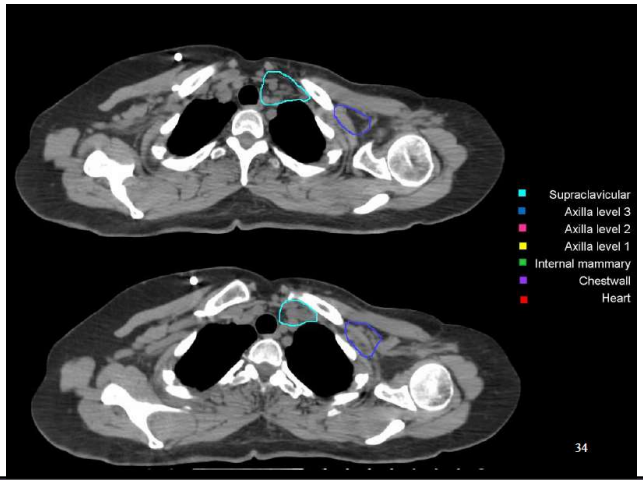
RTOG
RADIATION THERAPY ONCOLOGY GROUP

Contouring

Regional Nodal Contours: Anatomical Boundaries

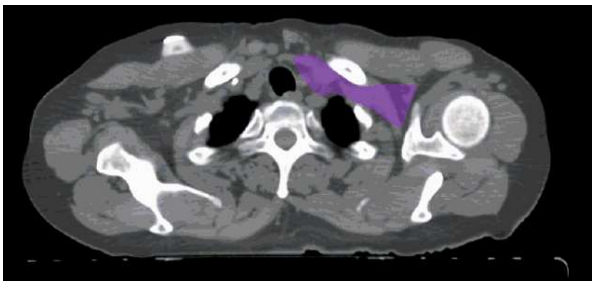
	Cranial	*Caudal*	*Anterior*	*Posterior*	*Lateral*	*Medial*
Supra-clavicular	Caudal to the cricoid cartilage	Junction of brachioceph.-axillary vns./ caudal edge clavicle head [a]	Sternocleido mastoid (SCM) muscle (m.)	Anterior aspect of the scalene m.	Cranial: lateral edge of SCM m. Caudal: junction 1st rib-clavicle	Excludes thyroid and trachea
Axilla-Level I	Axillary vessels cross lateral edge of Pec. Minor m.	Pectoralis (Pec.) major muscle insert into ribs [b]	Plane defined by: anterior surface of Pec. Maj. m. and Lat. Dorsi m.	Anterior surface of subscapularis m.	Medial border of lat. dorsi m.	Lateral border of Pec. minor m.
Axilla-level II	Axillary vessels cross medial edge of Pec. Minor m.	Axillary vessels cross lateral edge of Pec. Minor m. [c]	Anterior surface Pec. Minor m.	Ribs and intercostal muscles	Lateral border of Pec. Minor m.	Medial border of Pec. Minor m.
Axilla-level III	Pec. Minor m. insert on cricoid	Axillary vessels cross medial edge of Pec. Minor m. [d]	Posterior surface Pec. Major m.	Ribs and intercostal muscles	Medial border of Pec. Minor m.	Thoracic inlet
Internal mammary	Superior aspect of the medial 1st rib.	Cranial aspect of the 4th rib	- [e]	- [e]	- [e]	- [e]

Contouring



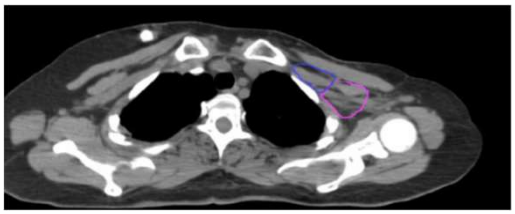
Contouring

- Patient number 14
- Left Chest wall
- Contour At Risk

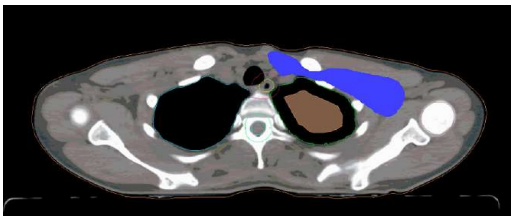


Contouring

RTOG Guideline



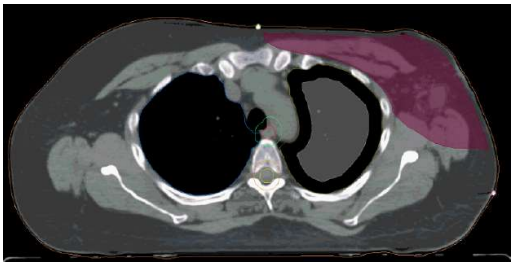
Patient 13 Left Chest wall



Contouring

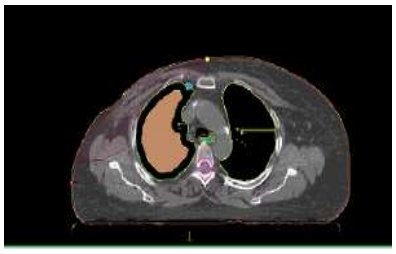
RTOG Guideline

Patient 15 Left Chest Wall



Contouring

IMN Axial Patient #11



IMN Sagittal

Contouring

- At patient # 5, I began drawing in the esophagus and avoidance structures. Spoiler alert Patient #5 is the one I re-planned.
- Monaco optimizes very well without avoidance structures.
- Avoidance structures most often drawn. Ipsilateral lung, and esophagus
- Started using "tuning" structures to control low doses primarily on the contralateral side

Normal Tissue Dosimetric Guidelines

Normal Tissue Dosimetric Guidelines

Quantec

- Ipsilateral Lung V20 <30% Dmean <20Gy
- Heart V30 <45% Dmean <26Gy
- Esophagus V50 <40% Dmean < 34 Gy

Normal Tissue Dosimetric Guidelines

RTOG 1304 Amendment 3

Ipsilateral Lung	V20 < 15-35 Gy	Range of acceptable variant
Heart	V25 < 10%	Dmean < 4 Gy </=5 Gy Acceptable variant

Normal Tissue Dosimetric Guidelines

- Esophagus V30 </= 10% Dmean < 12Gy

Normal Tissue Dosimetric Guidelines

Target Coverage

- Breast/ Chest Wall 90% - 95%>/= 50 Gy
- At Risk Nodes 90%-95% >/= 50 Gy
- IMN 80%-90% >/= 50 Gy

Normal Tissue Dosimetric Guidelines

- Exposure of the lungs in breast cancer radiotherapy: A systemic review of lung doses published 2010-2015
  - Marianne C. Aznar, Frances K. Duane, Sarah C. Darby, Zhe Wang, Carolyn W. Taylor
- The average mean ipsilateral lung dose with internal mammary chain irradiation was 14 Gy.
- Published 2017 Radiotherapy and Oncology

Normal Tissue Dosimetric Guidelines

- Post mastectomy intensity modulation radiated therapy of chest wall and regional nodes
- Retrospective analysis of the performance and complications up to 5 years
- Qiong Wang Phd, Wuyun Jie MD, Zhiwen Liang MD, Hongge Wu PhD, Jing Cheng PhD

Heart Doses V20 8.28% +/- 6.55%

Dmean (Gy) 6.99 +/- 3.01

- 200 patients in the study, only 101 received IMN irradiation
- 3 patients in this study were noted to have acute radiation esophagitis

Published 2017 Medicine

References

- Aznar MC, Duane FK, Darby SC, Wang Z, Taylor CW. Exposure of the lungs in breast cancer radiotherapy: A systematic review of lung doses published 2010-2015. Radiotherapy and Oncology 126 (2018) 148-154.
- Wang Q, Jie W, Zhiwen L, Wu H, Cheng J. Postmastectomy intensity modulation radiated therapy of chest wall and regional nodes. Retrospective analysis of the performance and complications up for 5 years. Medicine (2017) 96:39.
- White J, Tai A, Arthur D, Buckholz T, MacDonald S, Marks L, Pierce L, Recht A, Rabinovitch R, Taghian A, Vicini F, Woodward W, Li A. Breast Cancer Atlas for Radiation Therapy Planning: Consensus Definitions. Radiation Therapy Oncology Group website. https://www.rtog.org/CoreLab/ContouringAtlases/

18 Case Specifics

18 Case Specifics

- Laterality Breakdown: 5 Intact Right Breast, 4 Intact Left Breast, 5 Right Chest wall, 4 Left Chest wall. Total 18 patients
- Age range: 31-74 years
- Technique: DMLC 7-9 fields
- Energy: 6X and/or 10X
- 1 to 1.5 cm fluence was added to achieve "flash"
- We do DIBH on left sided breast or chest wall
- All scars and drain sites are included
- All patients received a tumor bed boost/scar boost of 10 Gy

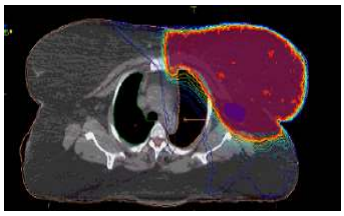
18 Case Specifics

Why did I do this?

- The physician put in his intent prescription include IMN "if possible."
- 3 of the early patients had PET+ IMN disease before chemo, and 1 had PET+ disease in the IMN upper mediastinum and supra clavicular nodes after chemo
- When compared, 3D mono-isocentric techniques were essentially inferior in basically every measure. Junction and transition areas between the nodes areas and the Breast/Chest wall volumes are particularly problematic with 3D.
- Once you start doing them with volumes it is hard to be satisfied with the results you get with 3D plans

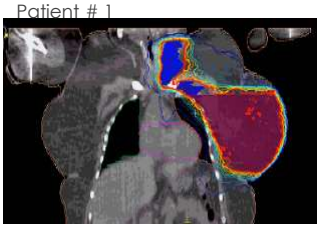
18 Case Specifics

Left Intact Breast Axial

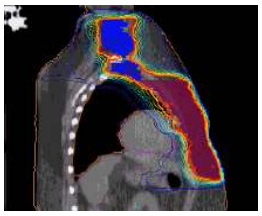


Left Intact Breast Coronal

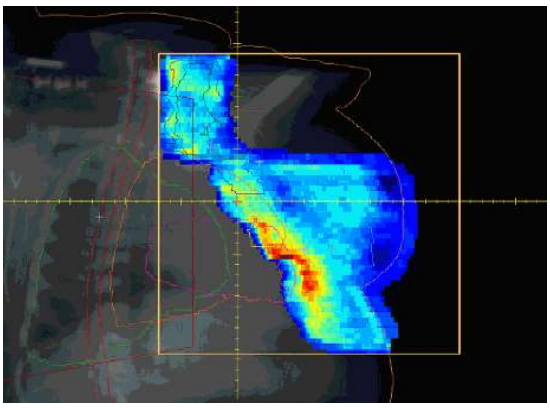
Patient # 1



Left Intact Breast Sagittal



18 Case Specifics



18 Case Specifics

Target Coverage

Patient #1 Left Intact Breast

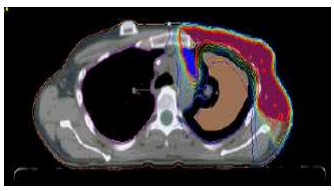
- Left Breast 95.1% @ 50 Gy
- At Risk Nodes 99.7 % @ 50 Gy
- IMN Dmean 49.7 Gy

OAR

- Left Lung V20 = 21.1%
  Dmean = 14.4Gy
- Heart V25 = 3.9%
  Dmean = 7.1 Gy

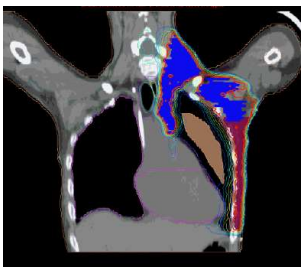
18 Case Specifics

Left Chest Wall Axial

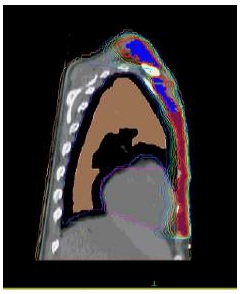


Left Chest Wall Coronal

Patient # 8



Left Chest Wall Sagittal



18 Case Specifics

Target Coverage

Patient # 8 Left Chest Wall

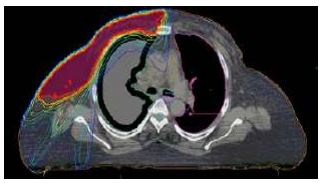
- Left Chest Wall 95.6% @ 50Gy
- At Risk Nodes 95.0% @ 50Gy
- IMN Dmean 50.9 Gy

OAR

- Left Lung V20 = 29.8%
  Dmean = 15.5 Gy
- Heart V25 = 8.2%
  Dmean = 8.6 Gy

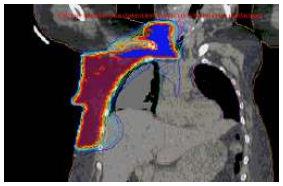
18 Case Specifics

Right Chest Wall Axial

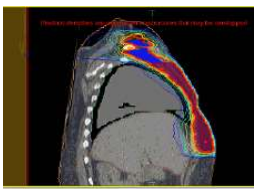


Right Chest Wall Coronal

Patient # 16



Right Chest Wall Sagittal



18 Case Specifics

Target Coverage

Patient # 16 Right Chest Wall

- Right Chest Wall 98.5% @ 50Gy
- At Risk Nodes 97.1% @ 50Gy
- IMN Dmean 50.5 Gy

OAR

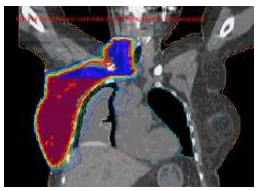
- Right Lung V20 = 21.3%
  Dmean = 12.6Gy

18 Case Specifics

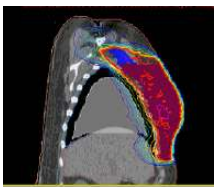
Right Intact Breast Axial

Right Intact Breast Coronal

Patient # 17



Right Intact Breast Sagittal



18 Case Specifics

Target Coverage

Patient # 17 Right Intact Breast

- Right Breast 99.6% @ 50Gy
- At Risk Nodes 95.7% @ 50Gy
- IMN Dmean 50.4Gy

OAR

- Right Lung V20 = 23.8%
  Dmean = 14.8Gy

18 Case Specifics

Objective

- 90%-95% of Breast / Chest Wall @ 50Gy
- 90-%95% of At Risk Nodes @ 50Gy
- Dmean of IMN @ 50Gy

Target Coverage Averages

- Breast/ Chest Wall 95.9%
- At Risk Nodes 97.25%
- IMN 50.1 Gy

18 Case Specifics

Dose Constraint Goals

- Ipsilateral Lung V20 </= 15-35 %
  Dmean < 14 Gy
- Heart V25 </= 10%
  Dmean < 4-5 Gy

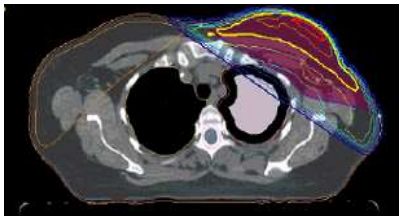
Results OAR

- Ipsilateral Lung V20 = 25.7 Gy
  Dmean 14.006Gy
- Heart V25 = 5.6%
  Dmean 7.6 Gy

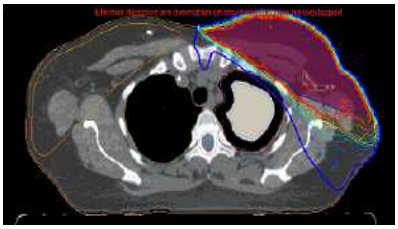
3 D Comparisons

3D Comparison

3D Left Breast Patient 4 Axial

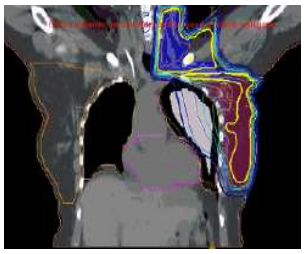


IMRT Left Breast Patient 4 Axial

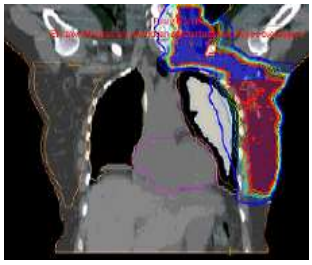


3 D Comparisons

3D Patient #4 Coronal

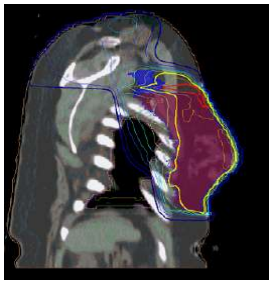


IMRT Patient #4 Coronal

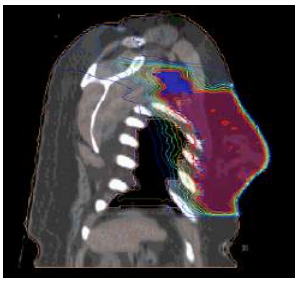


3D Comparison

3D Patient #4 Sagittal



IMRT Patient #4 Sagittal



3D Comparison

3D Coverage Patient #4

- Left Breast 81.1% @ 50Gy
- At Risk 66.8% @ 50Gy
- IMN Dmean 44.4 Gy
- Left Lung V20 30.6%
- Heart V25 1.2%

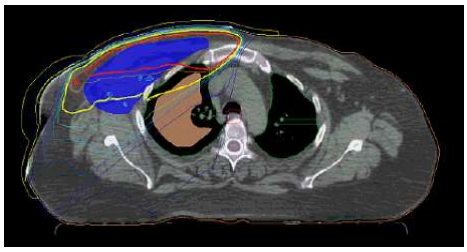
IMRT Coverage #4

- Left Breast 95.5% @ 50Gy
- At Risk 96.6% @ 50Gy
- IMN Dmean 50.3 Gy
- Left Lung V20 25.4%
- Heart V25 4.2%

3D Comparison

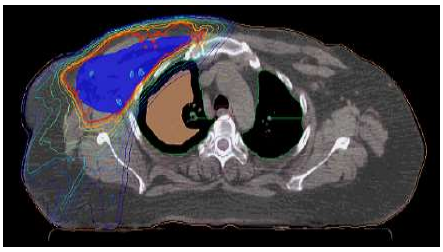
3D Right Chest Wall Patient #11

Axial



IMRT Right Chest Wall Patient # 11

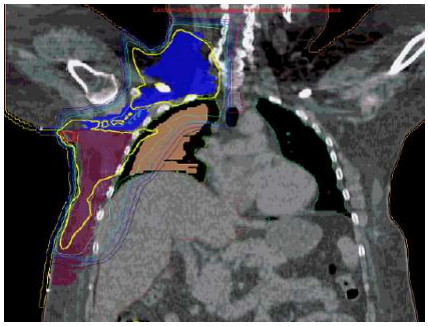
Axial



3D Comparison

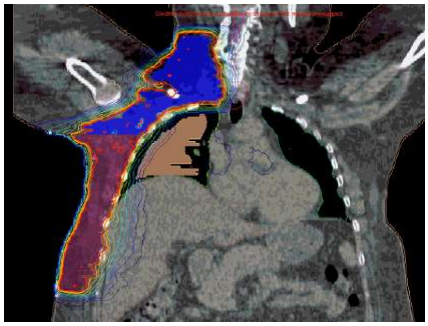
3D Right Chest Wall Patient #11

Coronal



IMRT Right Chest Wall Patient # 11

Coronal



3D Comparison

3D Right Chest Wall Patient #11

Sagittal

IMRT Right Chest Wall Patient # 11

Sagittal

3D Comparison

3D Coverage Patient #11

- Right Chest Wall 79.2% @ 50Gy
- At Risk 85.9% @ 50Gy
- IMN Dmean 57.3 Gy
- Right Lung V20 48.2%

IMRT Coverage #11

- Right Chest Wall 95.1% @ 50Gy
- At Risk 98.6% @ 50Gy
- IMN Dmean 51 Gy
- Right Lung V20 21.9%

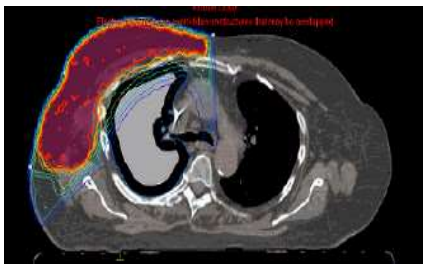
Retrospective Replan

Retrospective Replan

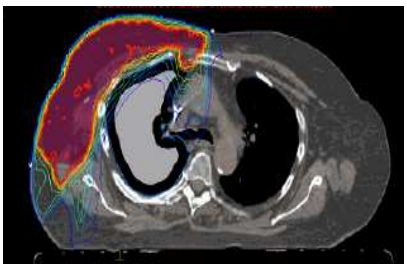
- Patient # 5 Right Intact Breast
- Was the only plan of the 18 that I did not 100% meet all of my dose goals
- IMN Dmean in the original plan was 38.6 Gy
- R Lung V20 went from 29.9% to 24.7%
- This patient was also re-planned to reduce esophageal dose at fraction #8 of 25
- In hind sight the optimization process was flawed from the beginning
- From this patient the esophagus/trachea is contoured and optimized to minimize pharyngitis

Retrospective Replan

Original Plan



Replan



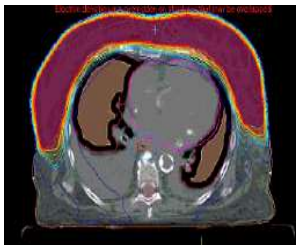
Retrospective Replan

Original		Replan	
Right Breast	95% @ 50 Gy	Right Breast	96.4% @ 50 Gy
At Risk	97% @ 50Gy	At Risk	97.5% @ 50 Gy
IMN Dmean	38.6 Gy	IMN Dmean	49.7 Gy
Right Lung	V20 = 29.9%	Right Lung	V20 = 24.8%

VMAT

VMAT

Bilat Breast Axial



Bilat Breast Coronal

Patient #19

Bilat Breast Sagittal

VMAT

Target Coverage

- Bilat Breast 99.2% @ 50 Gy
- Bilat Nodes 99.2% @ 50 Gy

OAR

- Bilat Lung V20 = 22.5%
  Dmean = 16.5 Gy
- Heart V25 = 2.2%
  Dmean = 13.7 Gy

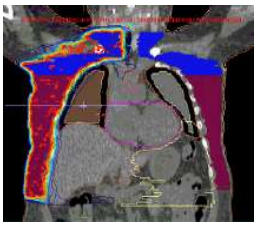
VMAT

- Patient # 20 Bilateral Chest Wall
- Inflammatory carcinoma on the right
- Invasive ductal carcinoma on the left
- Suspected skin nodularity starting on the right
- Incision infection on the left
- Right side must start ASAP , Left to follow

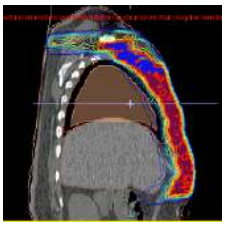
VMAT

R Chest Wall Axial

R Chest Wall Coronal



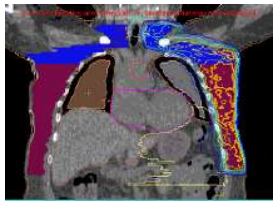
R Chest Wall Sagittal



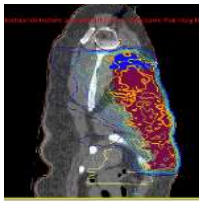
VMAT

L Chest Wall Axial

L Chest Wall Coronal

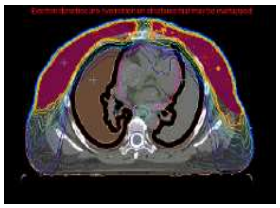


L Chest Wall Sagittal



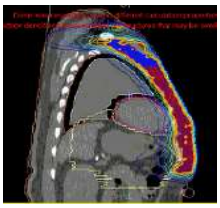
VMAT

Bilat Chest Wall Axial



Bilat Chest Wall Coronal

Bilat Chest Wall Sagittal



VMAT

- This case was is so recent that it has not completed treatment
- The left side will be treated with DIBH and with the DMLC technique

Discussion/Closing

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Considerations, questions and observations

- From the community perspective this area is very open to interpretations. It is difficult to discern from the literature whether you are comparing apples, oranges or bananas
- There are questions on contours, set ups positioning, immobilization
- DMLC/ VMAT vs 3D
- DIBH for the left side
- I am right in the learning curve of the next evolution.

Discussion/Closing

- After compiling this data, and based on our results we continue to abide by the OAR and Target levels in RTOG 1304.

Dose Goals

- Breast/chest wall Target 90%-95% >/= 50 Gy
- Ipsilateral Lung V20 </= 15-35%
- Heart V25 </= 10% Dmean <4-5 Gy

Discussion/Closing

- All in all I feel really good about what we did for this group of patients.
- I am interested in seeing if I can use VMAT in all cases.
- In the words of Oprah, "when you know better, do better."
- I am very interested in knowing what other people are doing, and exchanging experiences and ideas.
- Special thanks to : Gerard J Voorhees, MD
  Curtis Volgamore, MS, DABR

Discussion/Closing