Prone Positioning for Breast Radiation Therapy

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Disclosures

- No financial relationships
- No conflicts of interest

- NCCN Breast Cancer Guidelines Panel
- ASCO Post Mastectomy Radiation Guidelines Panel

ARS #1

- Familiarity with prone positioning for breast radiation:

1. No knowledge
2. Some knowledge but not available at my site
3. Some knowledge and available at my site
4. Routinely use at my site

Prone Positioning for Breast Radiation Therapy: Outline

- Learning objectives for the panel:
  - Review prone positioning from each of our perspectives
  - Provide an overview from clinical assessment throughout treatment
  - Engage in a practical and interactive discussion
  - Present RPCI and OSU modifications
  - Provide thoughts on starting a program

Prone Positioning for Breast Radiation Therapy: Outline

- Learning objectives for this part:
  - To define early stage breast cancer and review general treatment paradigms
  - To describe various adjuvant radiation treatment options in early stage breast cancer
  - To recognize patient and clinical factors that influence selection of prone positioning for treatment
  - To describe my assessment of prone positioning

Cancer Statistics

Estimated New Cases

Males			Females		
Prostate	220,800	26%	Breast	231,840	29%
Lung & bronchus	115,610	14%	Lung & bronchus	105,590	13%
Colon & rectum	69,090	8%	Colon & rectum	63,610	8%
Urinary bladder	56,320	7%	Uterine corpus	54,870	7%
Melanoma of the skin	42,670	5%	Thyroid	47,230	6%
Non-Hodgkin lymphoma	39,850	5%	Non-Hodgkin lymphoma	32,000	4%
Kidney & renal pelvis	38,270	5%	Melanoma of the skin	31,200	4%
Oral cavity & pharynx	32,670	4%	Pancreas	24,120	3%
Leukemia	30,900	4%	Leukemia	23,370	3%
Liver & intrahepatic bile duct	25,510	3%	Kidney & renal pelvis	23,290	3%
All Sites	**848,200**	**100%**	**All Sites**	**810,170**	**100%**

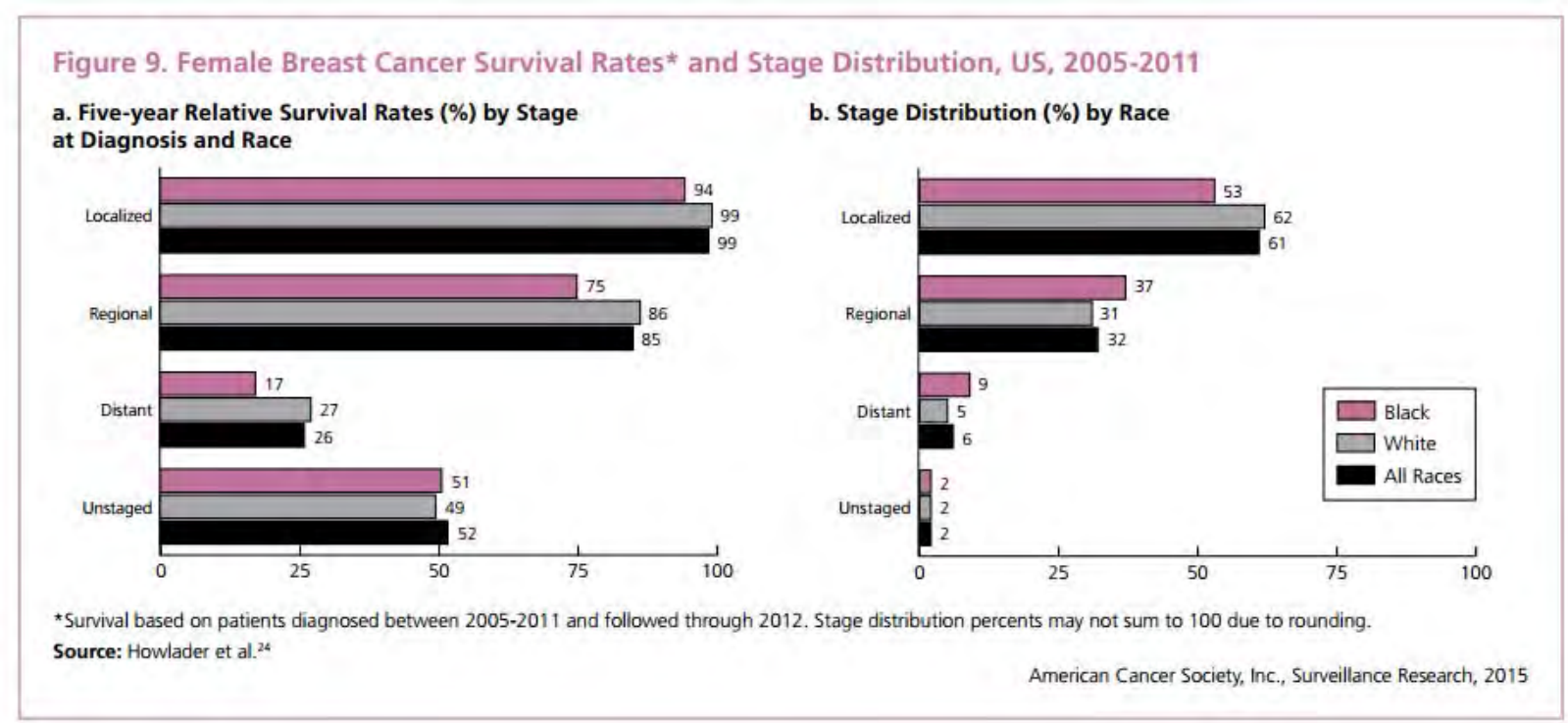
Estimated Deaths

Males			Females		
Lung & bronchus	86,380	28%	Lung & bronchus	71,660	26%
Prostate	27,540	9%	Breast	40,290	15%
Colon & rectum	26,100	8%	Colon & rectum	23,600	9%
Pancreas	20,710	7%	Pancreas	19,850	7%
Liver & intrahepatic bile duct	17,030	5%	Ovary	14,180	5%
Leukemia	14,210	5%	Leukemia	10,240	4%
Esophagus	12,600	4%	Uterine corpus	10,170	4%
Urinary bladder	11,510	4%	Non-Hodgkin lymphoma	8,310	3%
Non-Hodgkin lymphoma	11,480	4%	Liver & intrahepatic bile duct	7,520	3%
Kidney & renal pelvis	9,070	3%	Brain & other nervous system	6,380	2%
All Sites	**312,150**	**100%**	**All Sites**	**277,280**	**100%**

FIGURE 1. Ten Leading Cancer Types for the Estimated New Cancer Cases and Deaths by Sex, United States, 2015.
Estimates are rounded to the nearest 10 and cases exclude basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder.

Siegel et al CA Cancer J Clin 2015

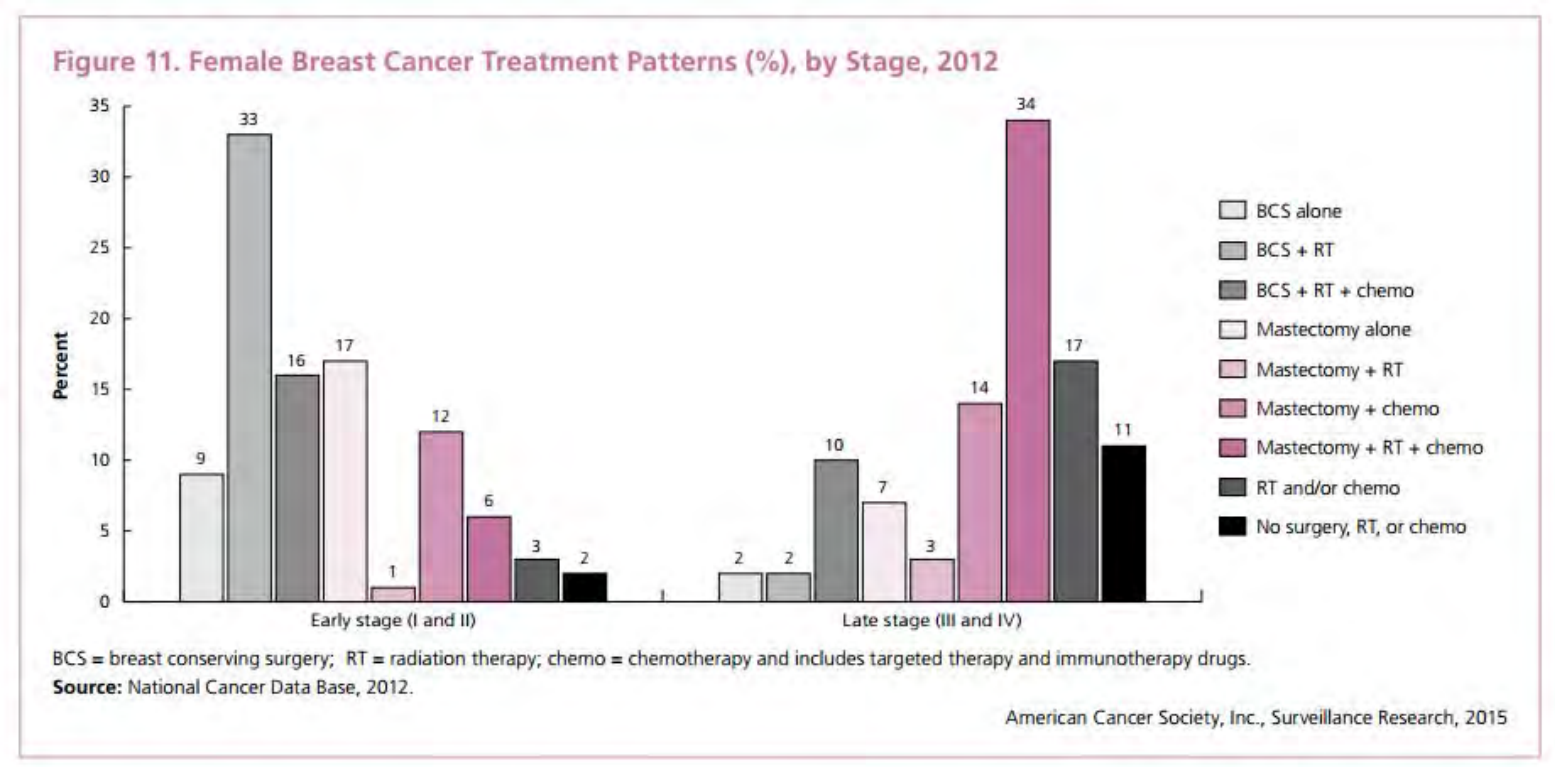
Breast Cancer Survival Rates by Stage Distribution



American Cancer Society

Breast Cancer Facts & Figures 2015-2016

Breast Cancer Treatment Patterns

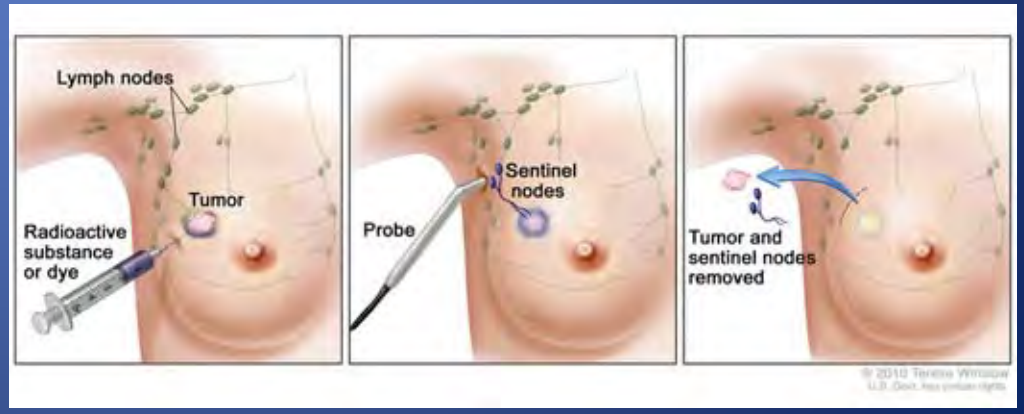


American Cancer Society

Breast Cancer Facts & Figures 2015-2016

Breast Cancer Treatment Options

- Surgical options:
  - For the breast:
    - Breast conserving surgery (lumpectomy)
    - Breast Conservation Therapy = surgery + radiation
    - Mastectomy +/- immediate reconstruction
  - For lymph node assessment:
    - Sentinel lymph node biopsy
    - Axillary lymph node dissection



Breast Cancer Treatment Options

- Systemic therapy options:
  - Chemotherapy
    - Can be given either before or after surgery
      - Neoadjuvant or adjuvant
      - Selection for use depends on stage and extent of disease, type of breast cancer and features (ER , PR, Her2 status), potential for down-staging to breast conservation, assessment of response
  - Endocrine therapy / hormonal therapy
    - Examples: tamoxifen, aromatase inhibitors, ovarian suppression

Breast Cancer Treatment Options

- Systemic therapy options:
  - What are gene recurrence score tests?
    Ex: “Oncotype Dx”
  - There are different tests

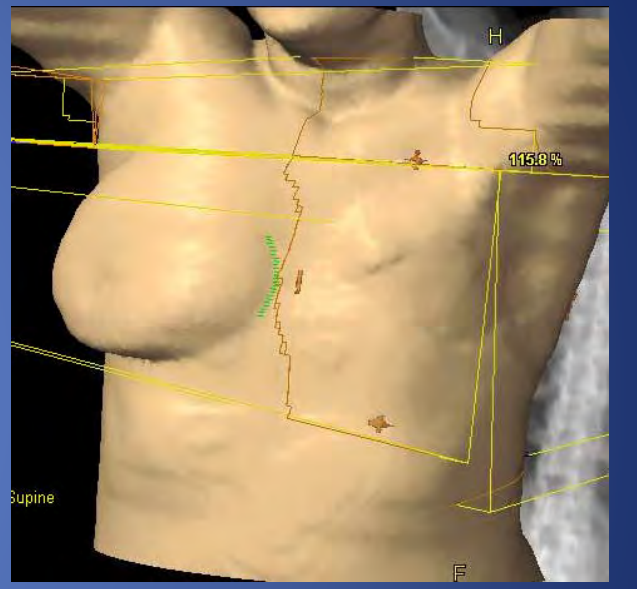
  - For invasive cancer to predict risk for distant recurrence and benefit of chemotherapy
    - Only for ER/PR positive Her2 negative tumors
  - For ductal carcinoma in situ (DCIS) to predict risk for recurrence—controversial

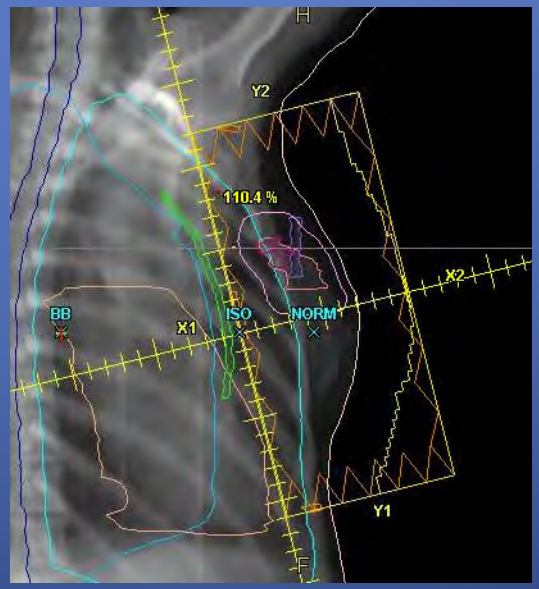
Rationale for Radiation

- Role of radiation in the setting of breast conservation and post mastectomy:
  - Improvement in local or locoregional control
  - Survival benefit in invasive carcinomas and in the post mastectomy setting
    - Disease free survival
    - Overall survival

Radiation Treatment Options

- TARGETS:
  - Whole breast
  - Partial Breast
  - Chest wall
  - Regional nodes



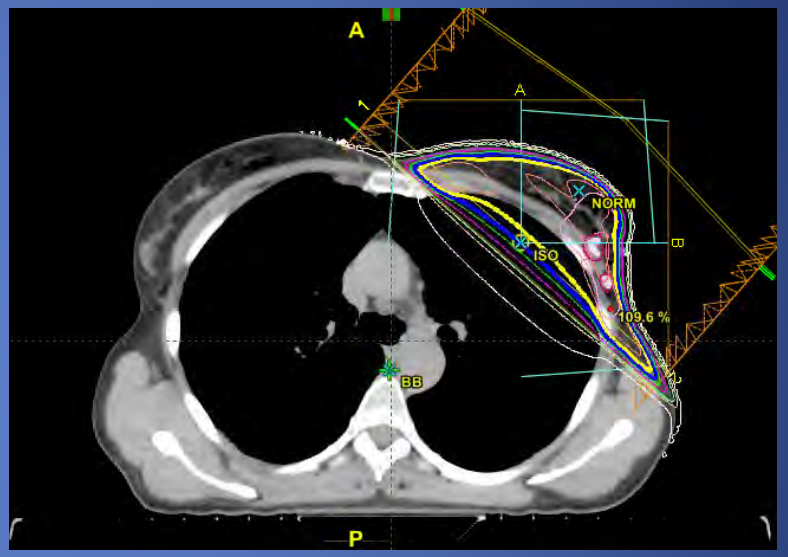


Radiation Treatment Options

- DOSE and FRACTIONATION
  - Conventional Fractionation
    - 1.8-2 Gy per fraction to total dose 45-50.4 Gy
  - Hypofractionation
    - Shorter course utilizing larger doses per fraction
    - >2 Gy per fraction to lower total dose
      - 40.05 – 42.56 Gy given in daily fxs for whole breast
      - 34-38.5 Gy given twice daily fxs for partial breast
  - Accelerated course
    - Treatment over shorter time course

Radiation Treatment Options

- MODALITIES:
  - External Beam
    - Photons
    - Electrons
    - Protons
  - Brachytherapy
    - Radioactive source
    - Device
  - Intraoperative
    - Various means



Radiation Treatment Options

- TECHNIQUES:
  - Positioning
    - Supine vs Prone
  - CT simulation and volume based planning
  - 3D conformal, e comp, IMRT
  - Respiratory control with deep inspiration breath hold technique
    - “respiratory gating”

Radiation Treatment Options

- In summary: MANY!

Radiation Treatment Options

- How is treatment tailored to the individual patient?
  - Patient factors
  - Treatment factors
  - Disease burden
  - Biology
  - Risks for disease morbidity vs treatment morbidity

Radiation Treatment Options

- Patient factors: age, comorbidities
- Treatment factors: type and extent of surgery, type of systemic therapy, response to neoadjuvant therapy
- Disease burden: T stage / size, N stage / # / ratio, ECE, LVSI, EIC, margins
- Biology: grade, ER, PR, Her2, gene profile

ARS #2

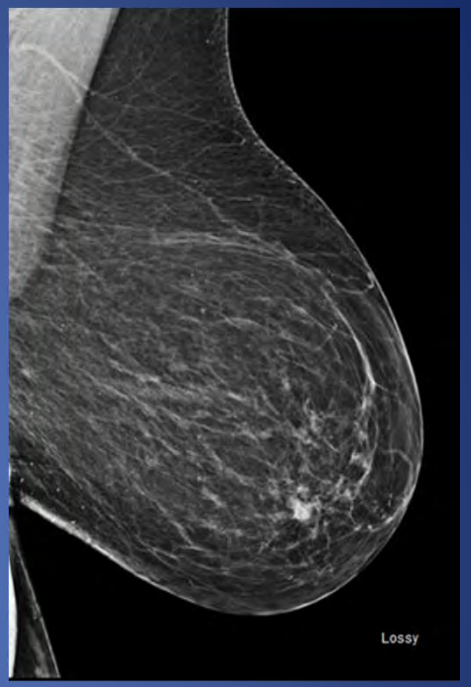
50 year old female with 3.5 cm of calcifications seen on screening mammogram. Bx proven DCIS, intermediate grade, ER/PR positive.

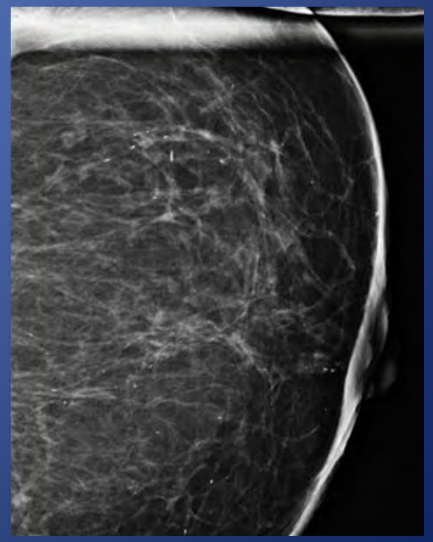
Opts for breast conservation.

pTis cN0 cM0, negative margins (3mm).

Negative post excision mammogram.

Sees you for breast RT recommendations…





ARS #2

1. Mastectomy
2. Whole breast +/- boost
3. APBI
4. No radiation
5. Clinical trial

Radiation Treatment Options

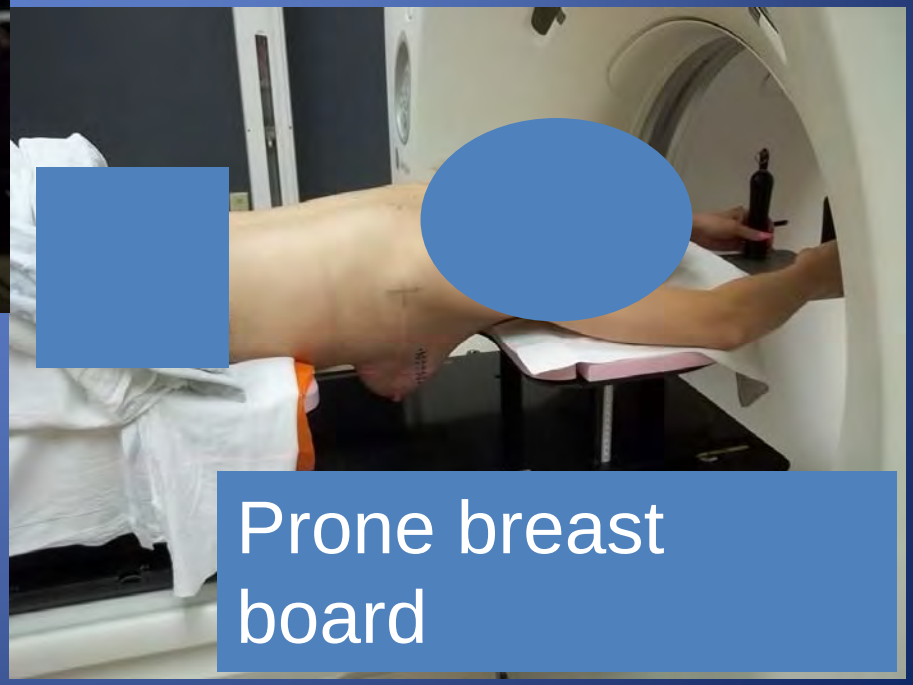
- Mastectomy
  - Unlikely would need PMRT
  - If contraindication to RT
- Whole breast +/- boost
  - Conv fx (5-6.5 wks) vs hypofx (3-4.5 wks)
- APBI
  - Intraop, Brachy, EBRT (1-10 fxs)
- No radiation (omission of RT)

Radiation Treatment Options

- Mastectomy
  - Unlikely would need PMRT
  - If contraindication to RT
- **Whole breast +/- boost**
  - Conv fx (5-6.5 wks) vs **hypofx (3-4.5 wks)**
- APBI
  - Intraop, Brachy, EBRT (1-10 fxs)
- No radiation (omission of RT)

Positioning Options:

Respiratory gating cube and glasses



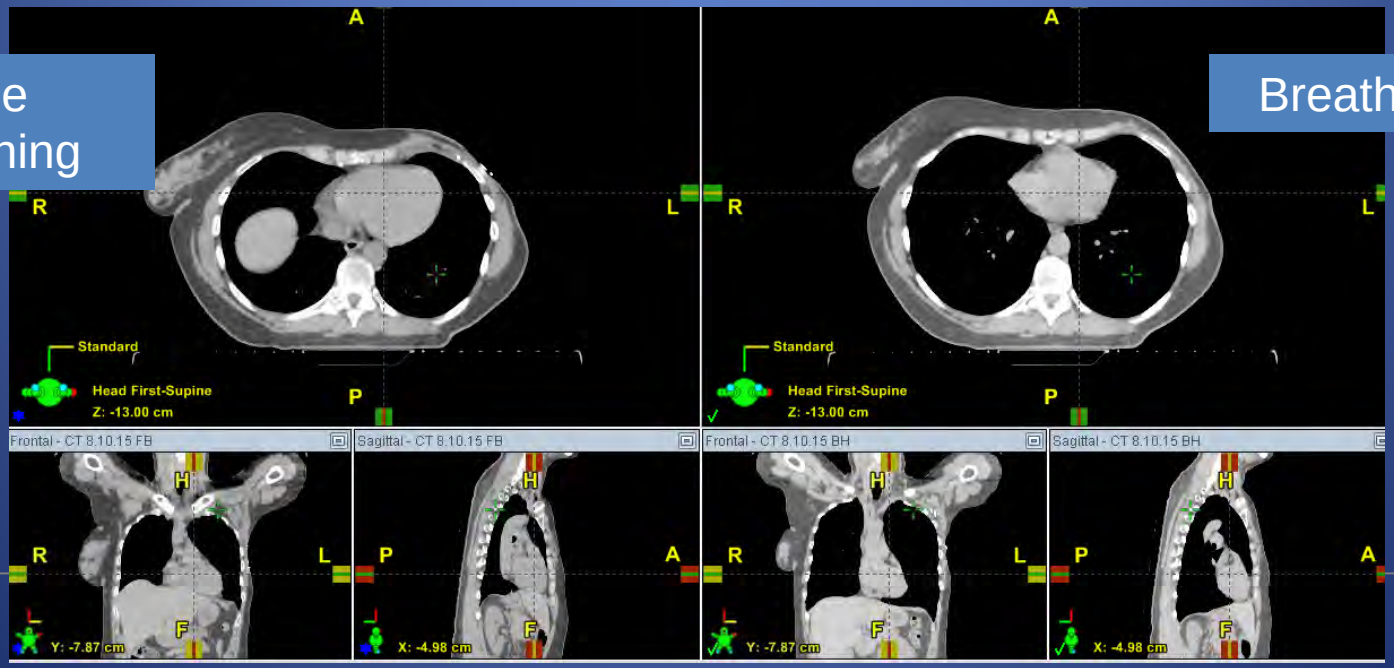
Prone breast board

Use of “Respiratory Gating”

- Breath hold technique
  - Moderate deep inspiration
  - Extra time, equipment, personnel, increased planning efforts and time for treatment

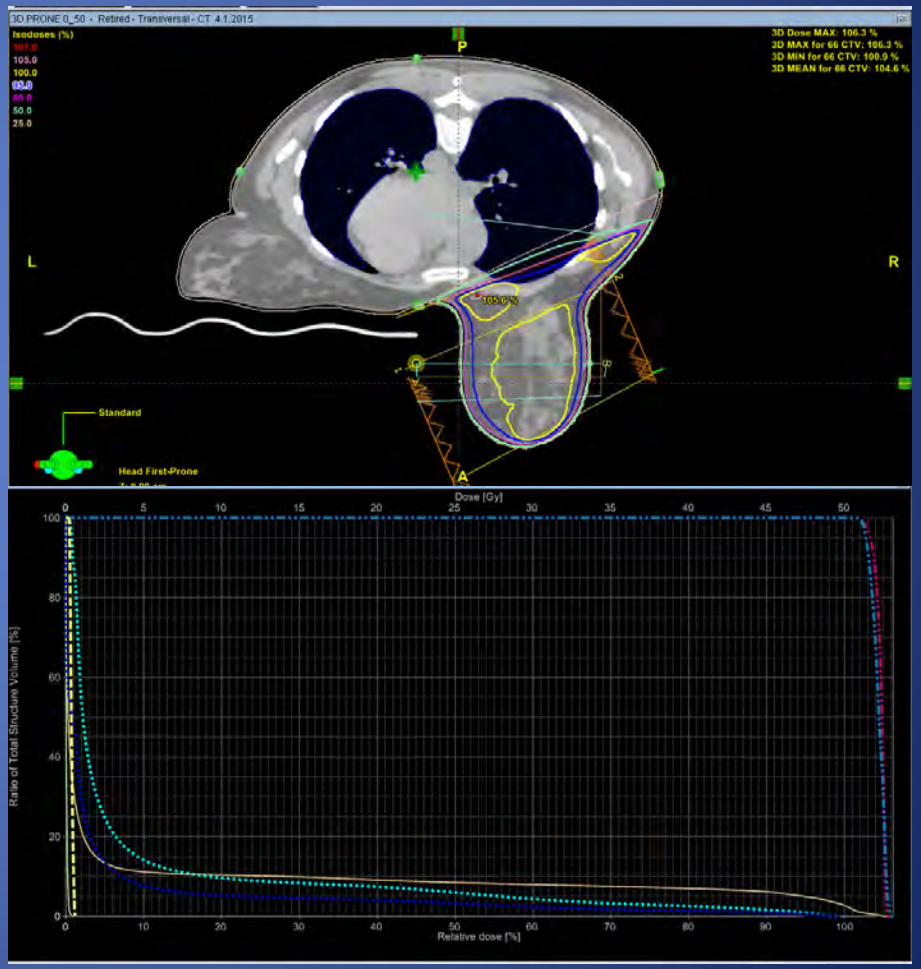
Free Breathing

Breath Hold



Use of Prone Positioning

- Select patients with early stage disease
- Breast is target
- Minimize normal tissue doses and treatment toxicity

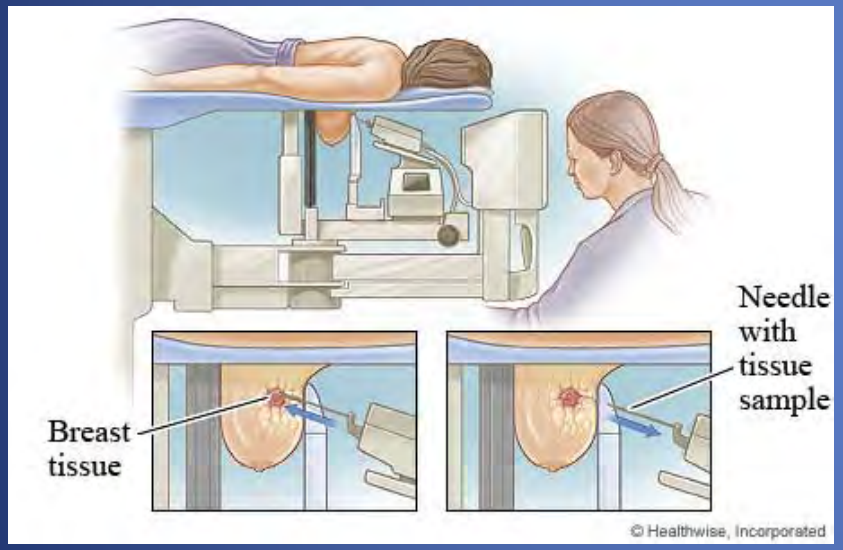


So why prone positioning?

- Thoughts on implementing prone positioning
- Important to have as an option for breast cancer treatment to minimize toxicity
- TEAM approach
- Requires active physician involvement and engagement throughout care (clinic, simulation, planning, verification, treatment)
- Learning curve

Rationale for Prone Positioning

- Prone position used for stereotactic core biopsy and breast MRI



- Technique adopted and modified for radiation treatment delivery

Images from WebMD and GE Healthcare

Rationale for Prone Positioning

- Displacement of breast tissue away from chest wall and torso
- Minimize acute and late skin effects
  - Minimize skin folds
  - Particularly in women in large pendulous breasts
  - High BMI/obesity
- Minimize dose to normal tissues
  - Lung
  - Heart
  - Medical co-morbidities: underlying pulmonary disease (COPD, smoker), cardiac disease, collagen vascular disease, prior RT

Early Experiences with Prone

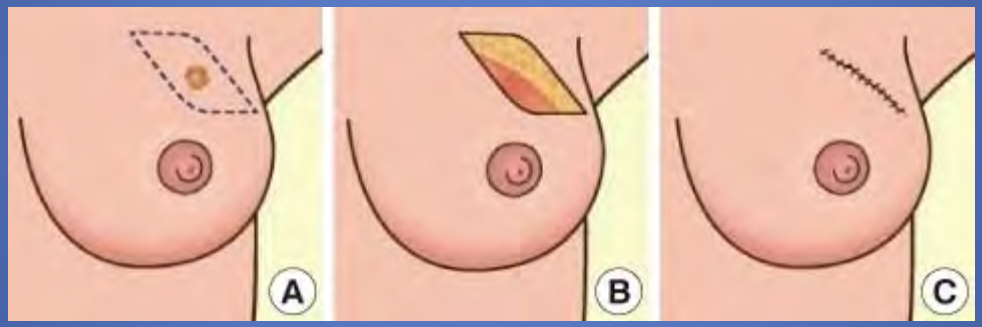
- MSKCC, USC, NYU, MCW, OSU, and others

- Whole breast
- Partial breast
- Concomitant boost
- Ongoing investigations for nodal regions, extended fields

- Lower lung doses
- Often lower heart doses
- Less skin toxicity
- No increased recurrences
- Reproducibility

Patient Selection for Prone

- Early stage disease
  - Stage 0, I, II
- Following breast conserving surgery



- **Target = breast tissue**
  - not chest wall
  - not lymph nodes
  - not post-mastectomy

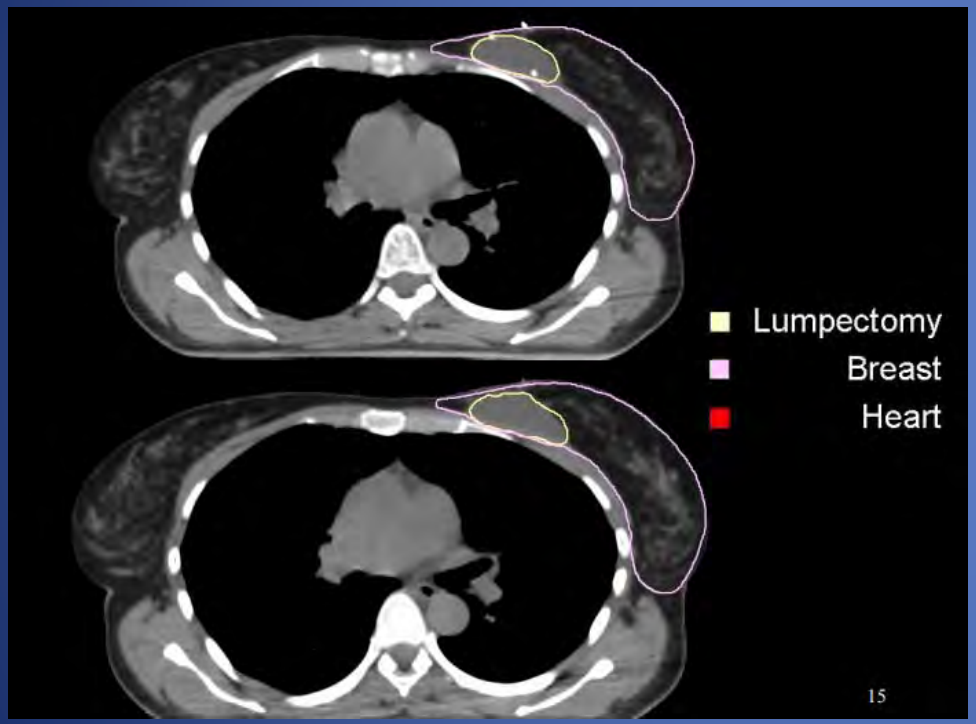
RTOG Contouring Atlas

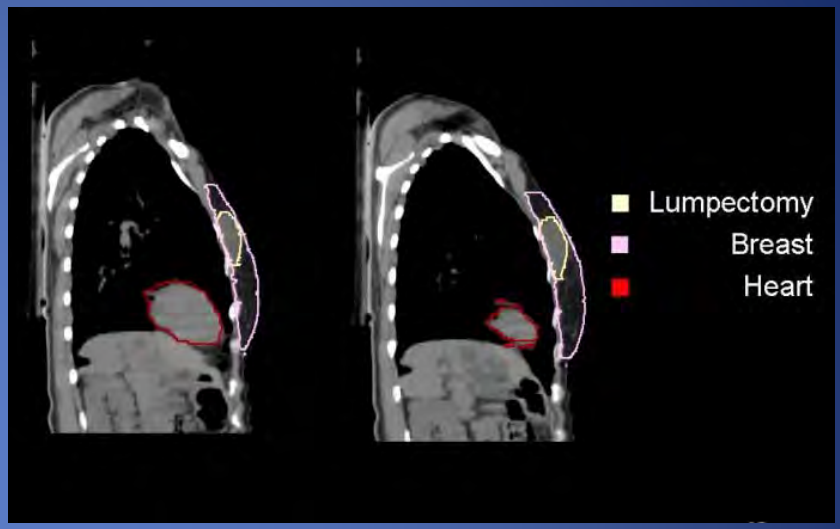
Definitions:

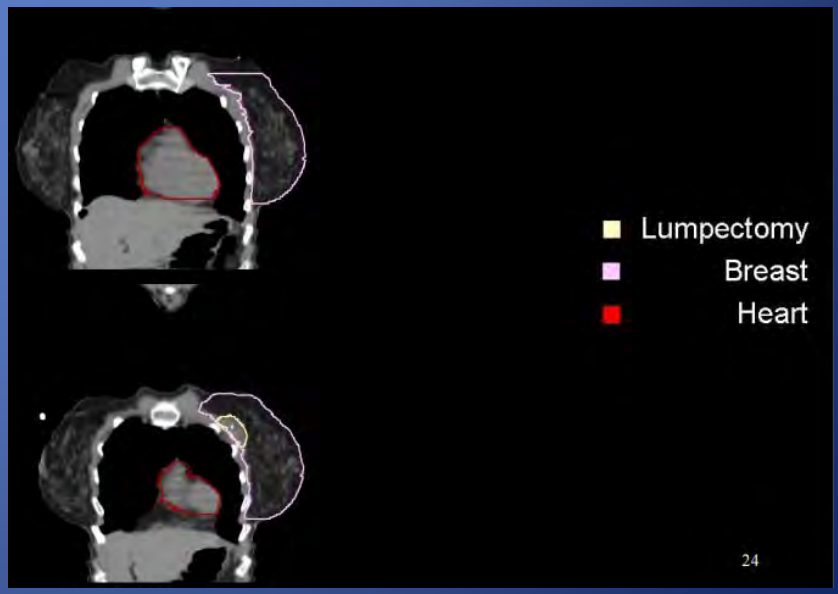
- Breast contour:
  - Clinical breast tissue
  - Includes lumpectomy CTV
  - Excludes pectoralis muscles, chest wall, ribs
- Chest wall contour:
  - From skin to rib/pleural interface
  - Includes pectoralis muscles, chest wall, ribs
- Breast + chest wall:
  - For more locally advanced / high risk patients
- Regional nodal volumes

White et al, RTOG Breast Cancer Contouring Atlas

Breast Contour

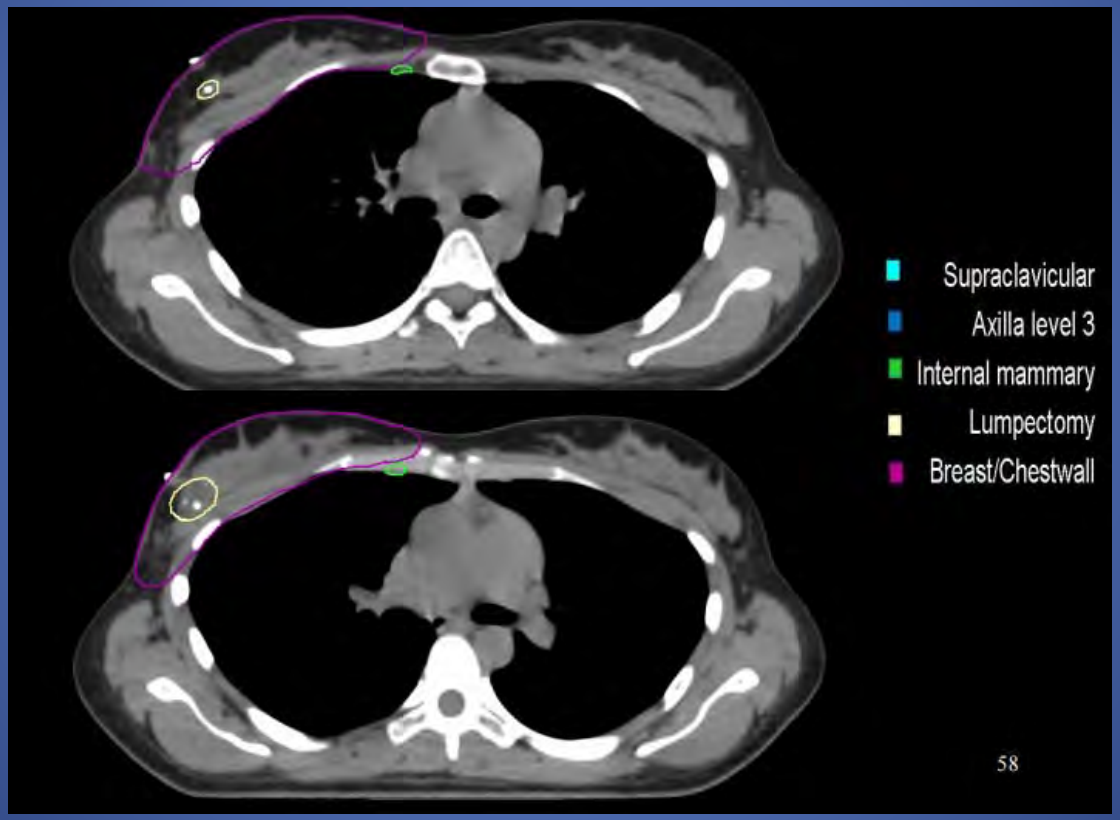






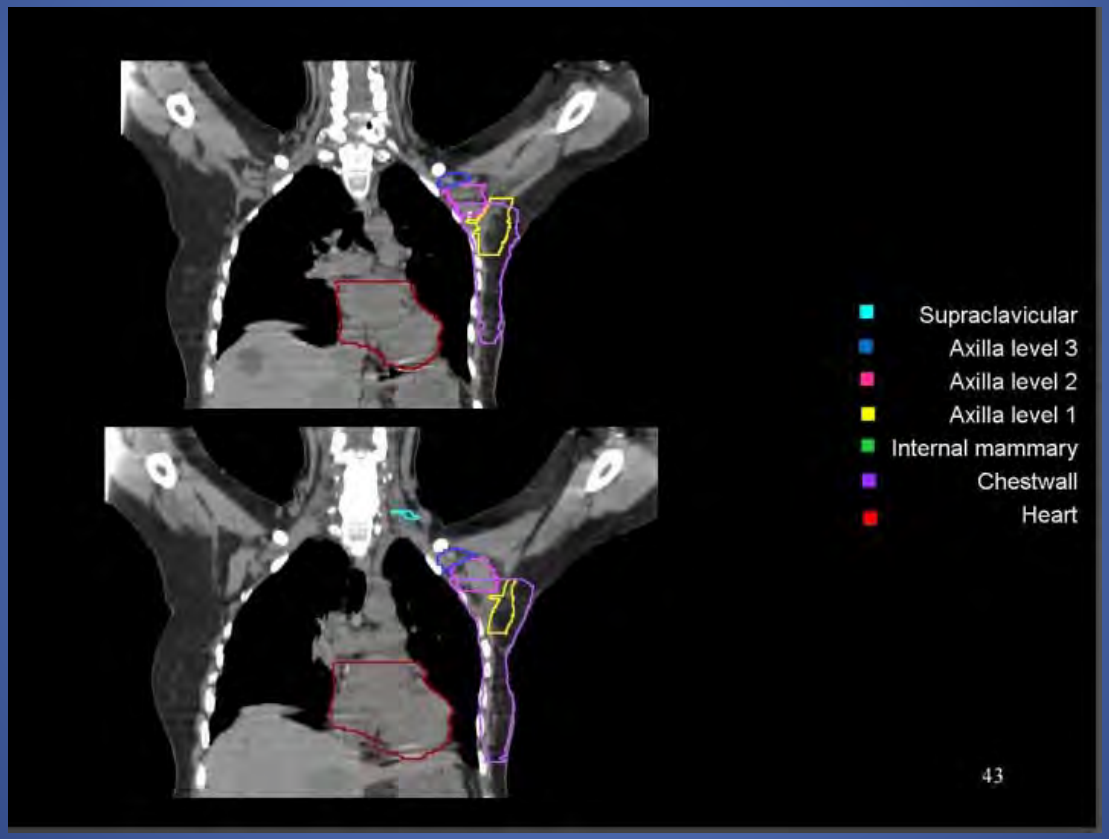
White et al, RTOG Breast Cancer Contouring Atlas

Breast + Chest Wall Contour



White et al, RTOG Breast Cancer Contouring Atlas

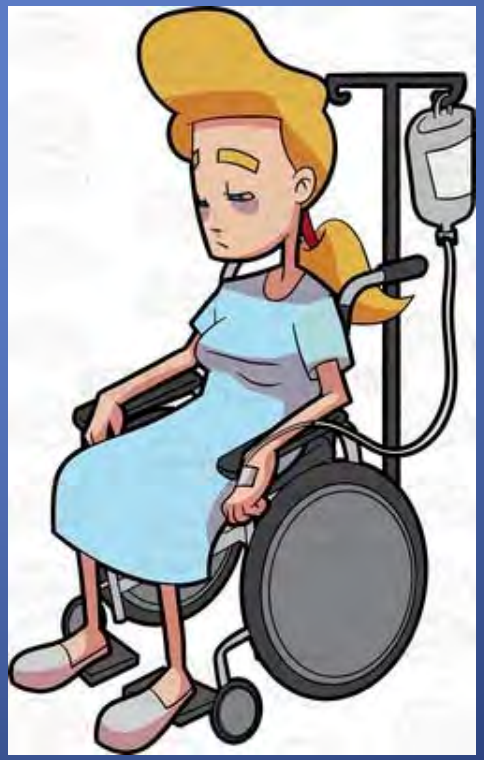
Regional Nodal Volumes Contours



White et al, RTOG Breast Cancer Contouring Atlas

Patient Selection for Prone

- Need to be able to get into the prone position and maintain stable position
  - Arm and neck range of motion
  - Back pain
  - Agility and flexibility
  - Body habitus
  - Respiratory status
  - Performance status



Patient Selection for Prone

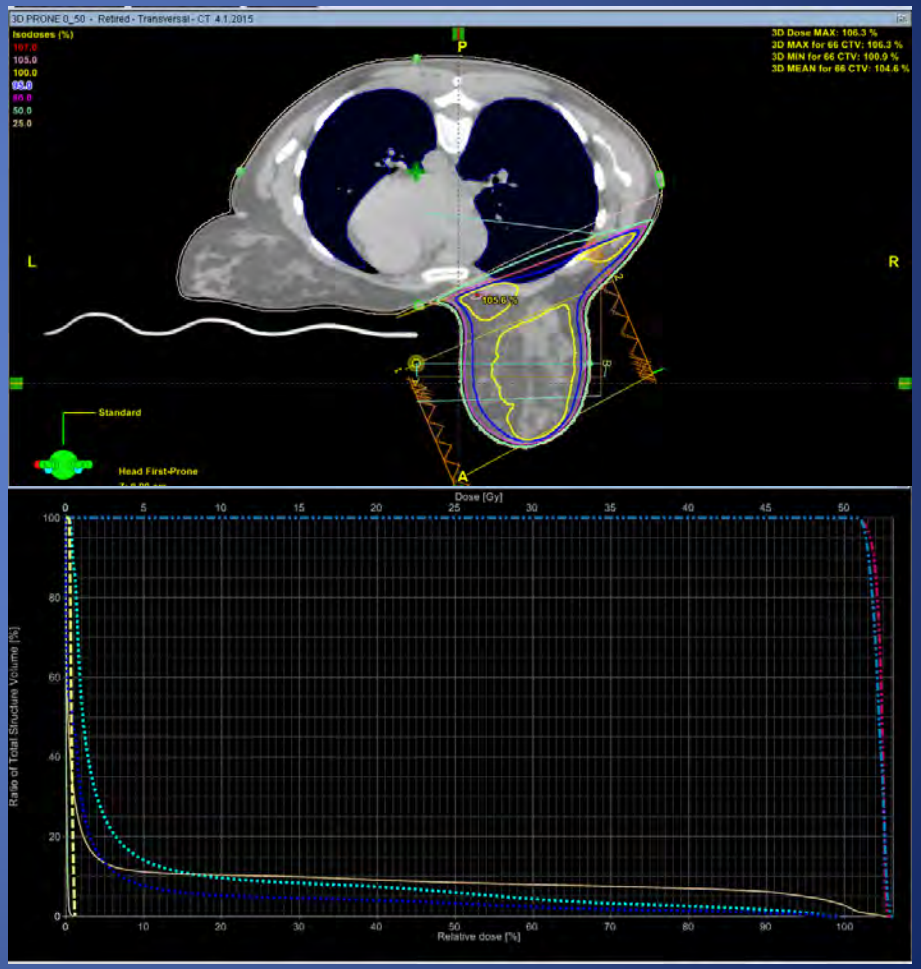
- Need to be able to get into the prone position and maintain stable position
  - Asking the patient about she tolerated prior biopsy procedure and / or MRI can be helpful

Patient Selection for Prone

- Other considerations:
  - CTV Location
    - Inner quadrants, particularly upper inner, can be challenging
    - Anterior/skin extent
    - Posterior extent of disease and proximity to chest wall/pectoralis muscles

Use of Prone Positioning

- Select patients with early stage disease
- Breast is target
- Minimize normal tissue doses and treatment toxicity



Limited Nodal Coverage with Tangents in Prone Position

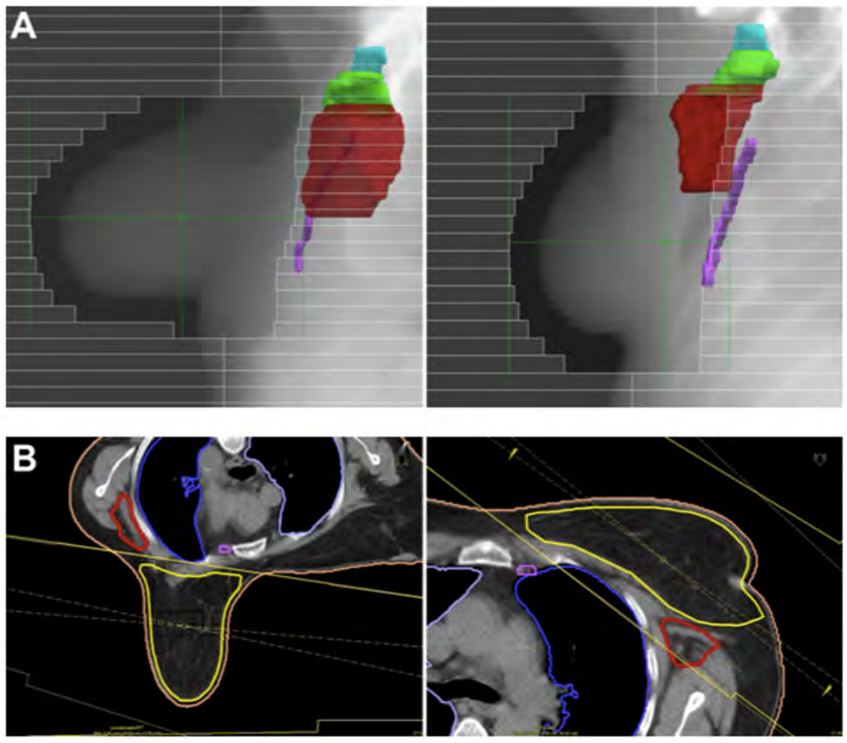


Figure 1 (**A** and **B**) Left-sided whole-breast irradiation. (**A**) Beam's eye view of the right anterior oblique field, with 3-D reconstruction of axillary levels I–III and internal mammary lymph-node regions in the prone and supine positions. (**B**) Typical field arrangements and their relation to the node regions.

Csenka et al, Therapeutics and Clinical Risk Management 2014

Limited Nodal Coverage with Tangents in Prone Position

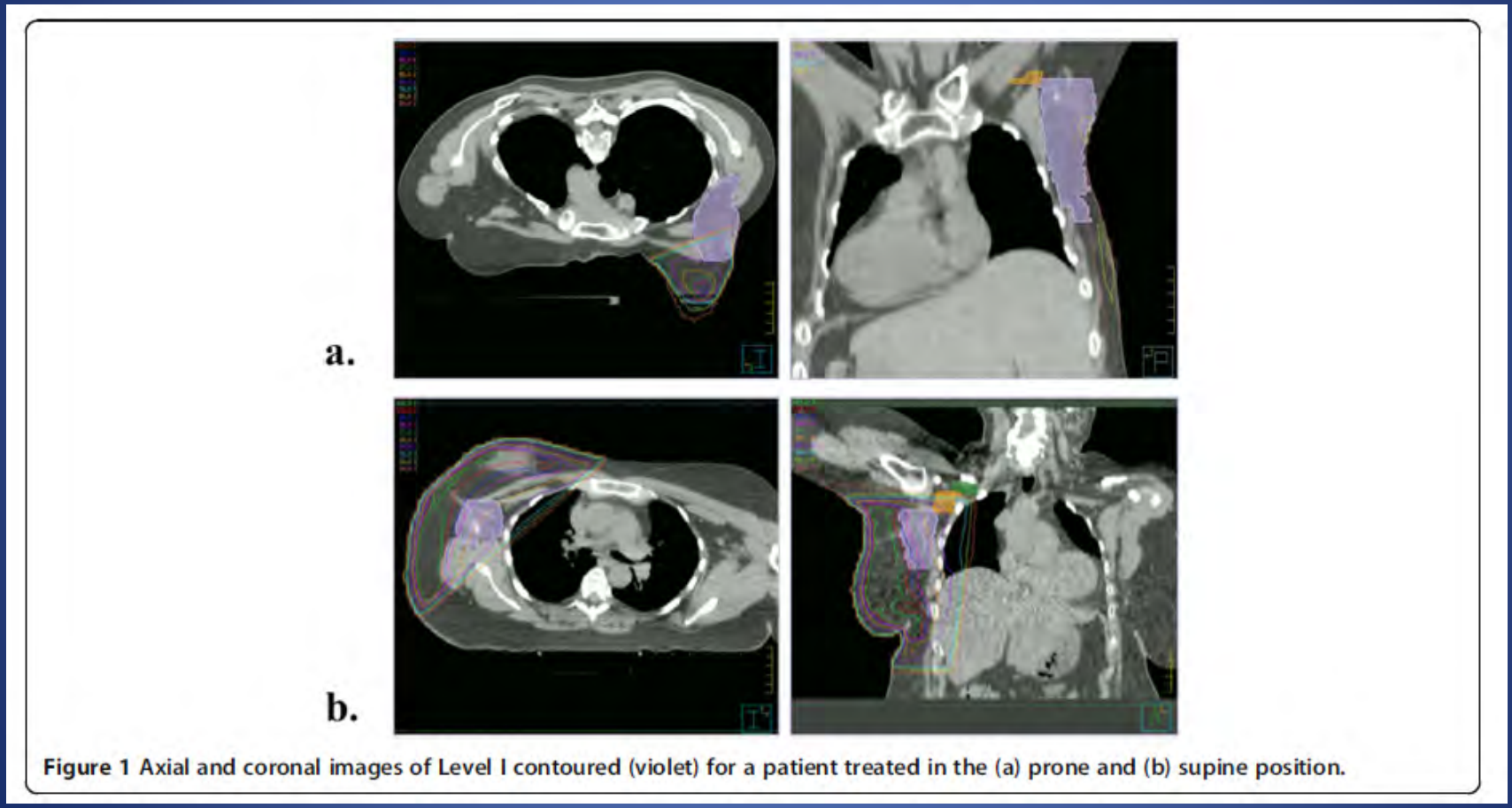


Figure 1 Axial and coronal images of Level I contoured (violet) for a patient treated in the (a) prone and (b) supine position.

Leonard et al, Radiation Oncology 2012

Options to Minimize Cardiac Dose

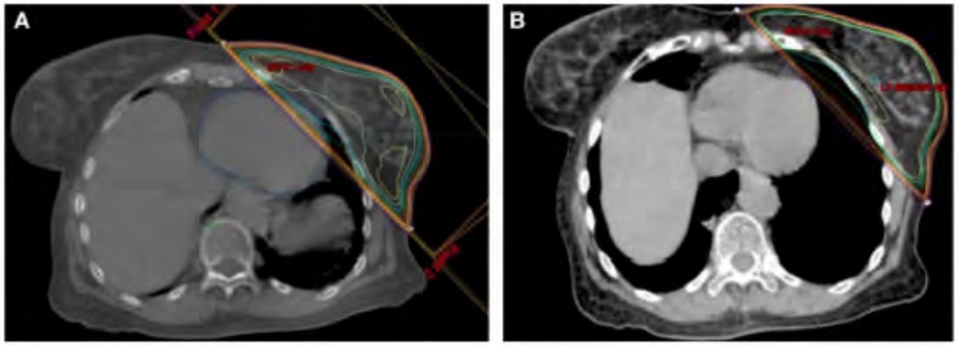


FIGURE 1 | Example of (A) free breathing and (B) deep inspiration breath hold plans for a single patient.

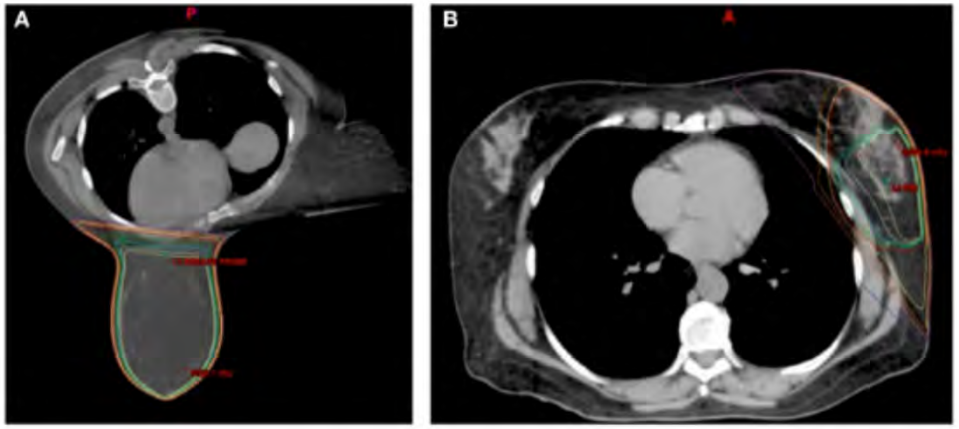


FIGURE 2 | Examples of (A) prone breast and (B) external beam APBI plans.

Beck et al, Frontiers in Oncology 2014

Positioning and Heart Location

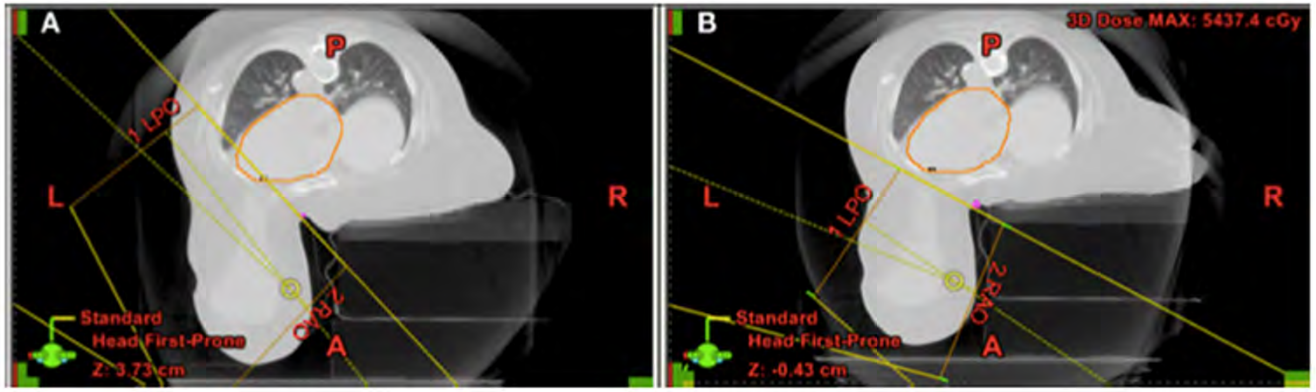
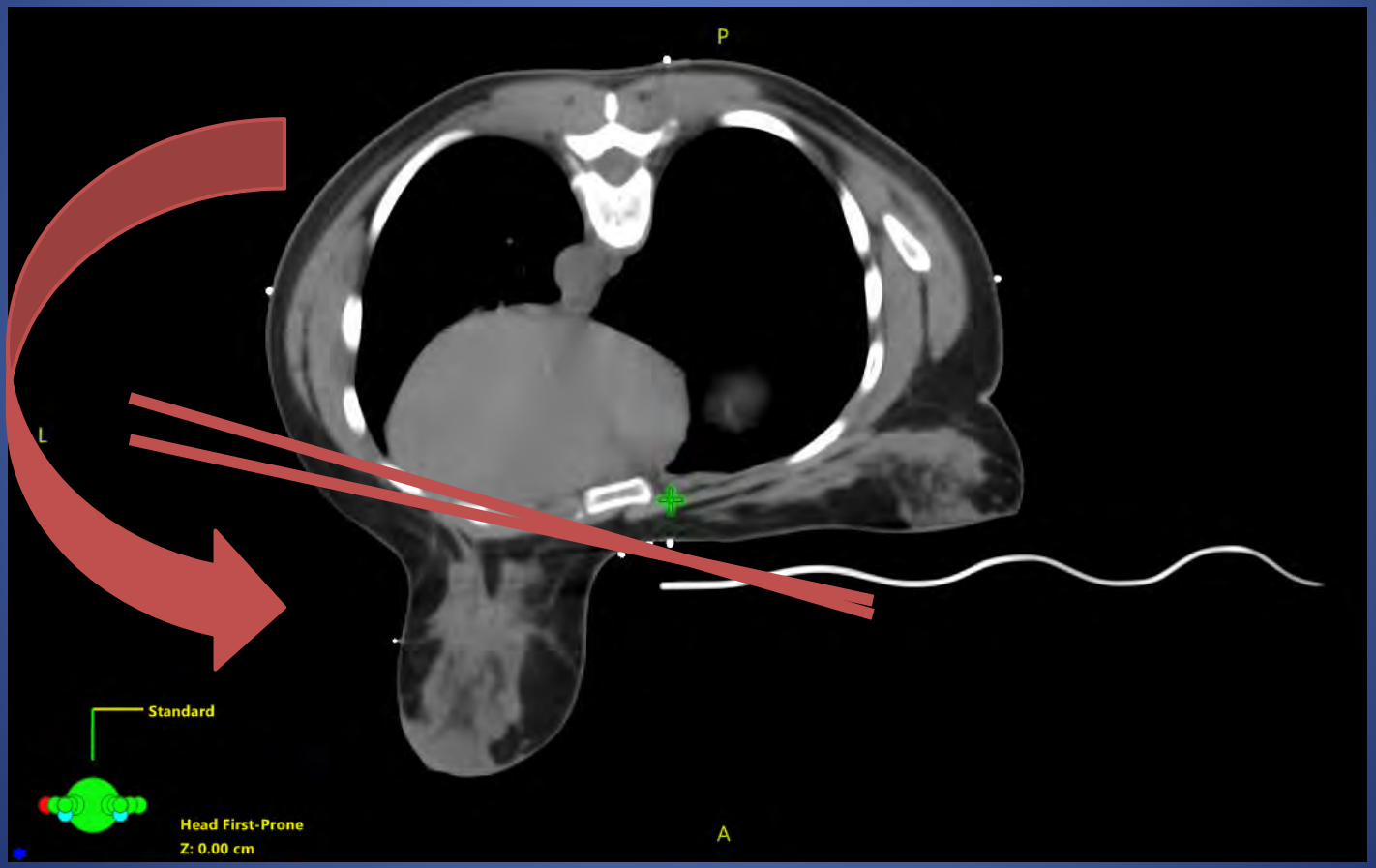


FIGURE 7 | (A) Initial set up with the sternum lateral to the edge of the mattress and the contralateral breast creating a wedge at the midline. To avoid the contralateral breast the angle of the tangents would include part of the heart and LAD. **(B)** Once correctly aligned with the sternum more medial toward the edge of the mattress and the contralateral breast better displaced, the angle of the tangents permits exclusion of the contralateral breast, heart, and LAD, while including the entire parenchyma of the index breast (lateral edge is just anterior to the latissimus dorsi).

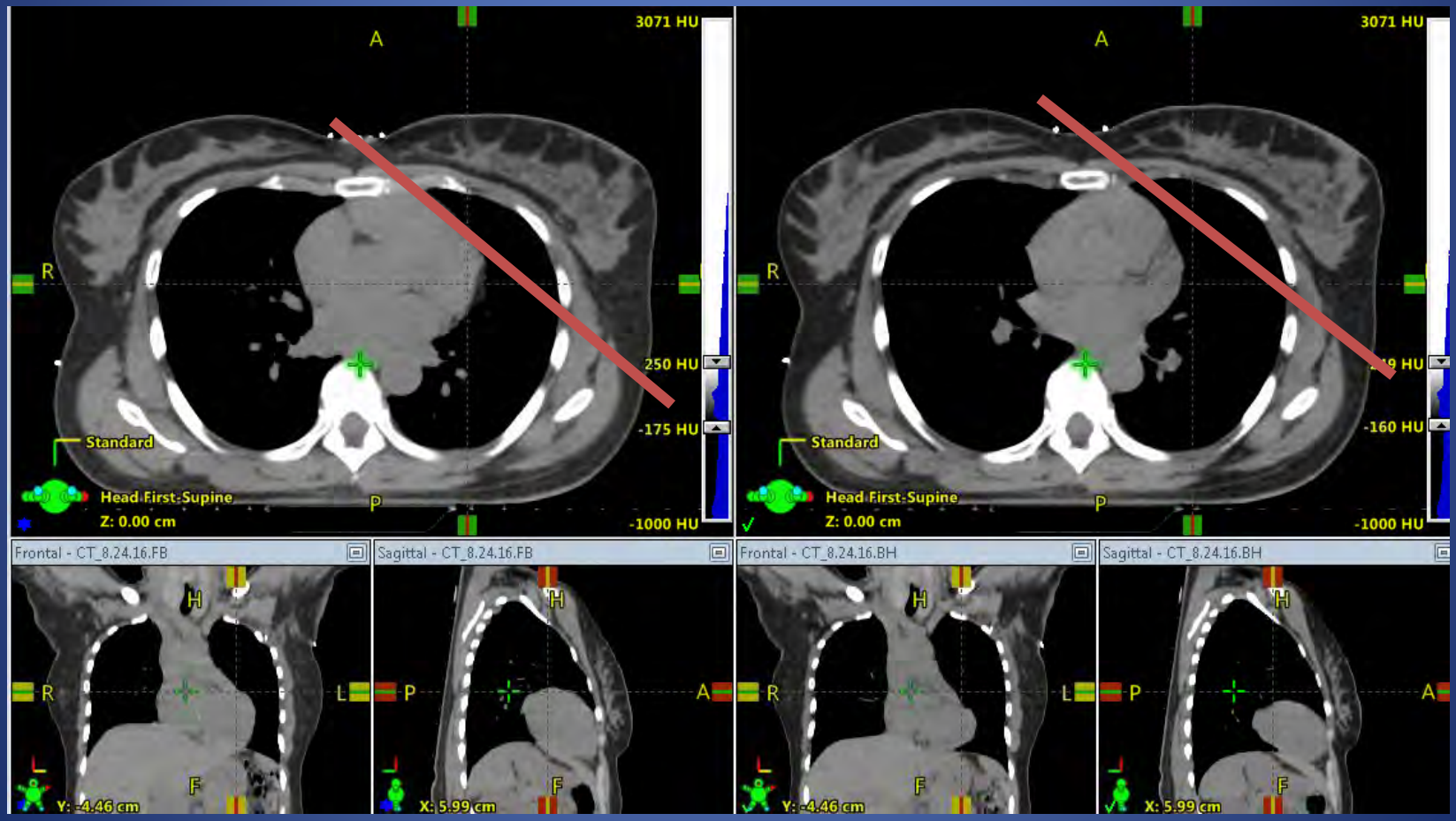
Huppert et al, Frontiers in Oncology 2011

Review of breast MRI can be helpful

Assessment at Simulation



Assessment at Simulation



Assessment at Simulation

- Physician presence to check set up wires, marks, positioning and reproducibility, anticipated tangent fields and heart and lung dose

- Set up, positioning, simulation, verification, daily treatments to be addressed by our next speaker…

Questions?

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