


**AAMD Region VI Meeting
November 3 – 4, 2017
Columbus, Ohio**

Prone Breast, Pre-Surgery. A case study; The OSU Way.

Karla Kuhn, CMD, RT(R)(T)
Lee Culp, M.S. CMD, RT(T)


November 2017

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 **THE OHIO STATE UNIVERSITY**
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Columbus, OH Region VI Meeting

Creating a cancer-free world. One person, one discovery at a time.



The Ohio State University Comprehensive Cancer Center – Arthur G. James Cancer Hospital and Richard J. Solove Research Institute.

296 Feet 9 Inches

14th Tallest Healthcare Facility in the USA,
23rd Tallest in the World

New The James
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- Third largest cancer hospital in the nation
- 21 stories
- 1.1 million square feet
- 306 inpatient bed, including 36-bed BMT unit
- 140 ICU beds
- 14 operating rooms
- 6 interventional radiology suites
- 7 linear accelerators for Radiation Oncology
- Dedicated early-phase clinical trials unit
- Opened December 14th 2014

We are here!



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Disclosures

- No disclosures relative to the presented material
- The following presentation is a reflection of studies, protocols, and opinions
- No Honorarium has been received in regards to the subsequent material
- Eclipse™ v.13.6.30

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Meet the Speaker

- Karla Kuhn, CMD RT(R)(T)
- 9 years Radiation Therapist
- 11 years in July as a Dosimetrist
- Lead Dosimetrist at SSCBC in August 2014



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Meet the Speaker

- Lee Culp, M.S CMD RT(T)
- Dosimetrist at OSU – SSCBC – 2.5 years
- Masters in Dosimetry from University of Wisconsin – La Crosse
- Has two Bachelors degrees – one in Communication and the other in Business



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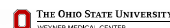
5

Radiotherapy at OSU

- The “New” James Cancer Hospital
 - Opened December 2014
 - All disease sites except Breast
- Stefanie Spielman Comprehensive Breast Center - SSCBC
 - Opened January 2011
 - All Breast and Breast metastasis



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Our Clinic




**The Stefanie Spielman
Comprehensive Breast Center (SSCBC)
at the Ohio State University**

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Breast cancer Epidemiology

- Most commonly diagnosed cancer among women
- Second leading cause of cancer death among women after lung cancer
- Annual Diagnosis
- Death Rate
- Lifetime risk of dying from Breast Cancer ?

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History of Breast Cancer – an evolution with time

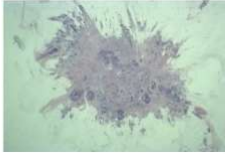

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First documented cases

- When was Cancer first diagnosed?
- What about Breast Cancer?
- In 460 B.C *Hippocrates* named cancer “Karkinos” a Greek word for crab



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10 <https://www.slideshare.net/drmcbansal/presentation-for-public-awareness>

First documented cases



- 440 B.C. Greek historian *Herodotus* recorded the Queen of Persia, *Atossa*, noticed a bleeding lump in her breast.

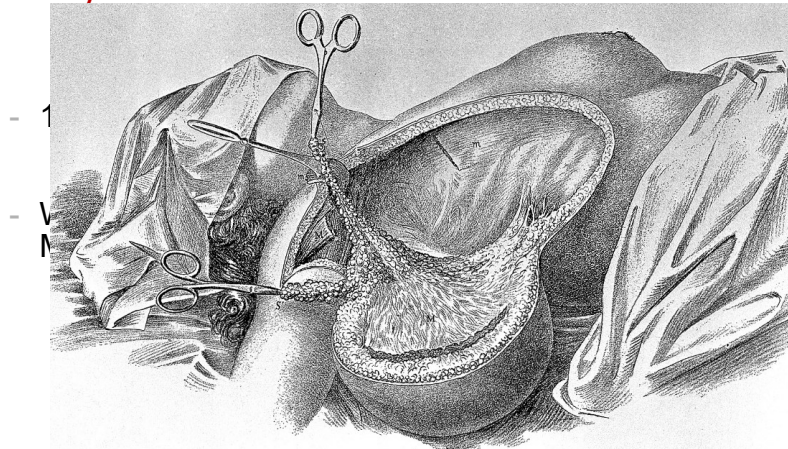
- Wrapped herself in sheets and sought a self-imposed quarantine, ashamed by the tumor
- This tumor was excised by her Greek slave, *Democedes*

<https://en.wikipedia.org/wiki/Atossa>

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Early Treatments



- Theorized that breast cancer spread locally into muscle, regional nodes, and then distant metastasis

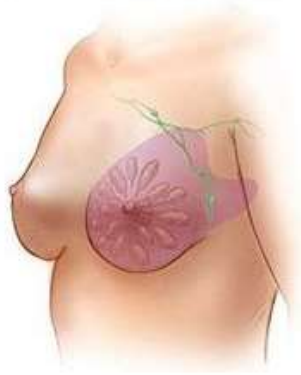
https://en.wikipedia.org/wiki/Radical_mastectomy

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Radical Modified Mastectomy

Modified radical mastectomy



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http://www.isabos.com/wp-content/uploads/2012/12/Mastectomy_Simple_MRadical1.jpg

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Early Stigma's of Breast Cancer

- For most of the 20th century, cancer was a word to be avoided in polite conversation
- In the 1950's a woman called the *New York Times* to place an ad for a Breast cancer survivors group

Carried a Negative Stigma

- In the 1950s people would be confused about Breast cancer because there wasn't enough information

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Changes in Mentality of Treatment

- Historically there was not much documented about the disease, nor treatment
- Only until recently in the 1990s did we see REAL advances
- Today you may be confused about treatment and Breast Cancer as a whole

- Post-operative vs. Intra-operative vs. Pre-operative



Evolution of RadioTherapy Breast Planning

Where did we come from?

Supine 2D – The Past

- Done by Simulator
- Borders marked visually by Physician with wire
- Half-beam blocked technique
- Gantry angle chosen from crossing of medial and lateral wires
- Standard of 2 cm of lung treated
- Used mobile contour plotter to achieve a 2D treatment plan



Evolution of Breast Planning at SSCBC

3D – The Present

- Free Breathing → DIBH → Prone
- Done by CT Simulator
- Border is marked visually by Physician with wires to use as a guide when contouring
- Dosimetrist contours Organs at Risk; MD contours target volumes
- Dosimetrist utilizes all 3D tools: Conformal, and if necessary, Static field IMRT planning to achieve our Dosimetric goals

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Evolution of Breast Planning (cont'd)

Where are we going?

- The Future of Breast Planning:
Protocol OSU 13282 – Feasibility of assessing Radiation Response with MRI/CT Directed *Pre-Op* Accelerated Partial Breast Irradiation in the *Prone* Position for Hormone Response early stage Breast Cancer

*Partial Breast Irradiation Pre-Op in the Prone position using MRI/CT fusion guidance

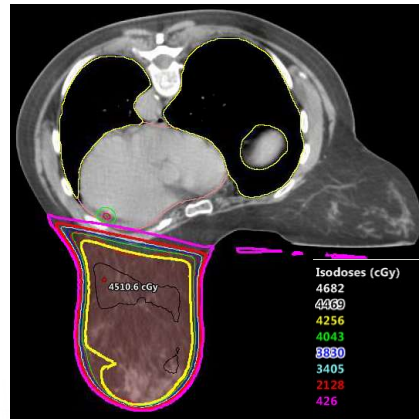
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Benefits Prone Breast Radiotherapy

- Better dose homogeneity due to smaller separation
- Reduces skinfolds
- Distances the breast from the chestwall
- Reduction in chestwall Motion



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Indications for Prone Breast Radiotherapy

- Breast size is not necessarily an indicator for prone RT
 - Larger and/or pendulous breasts
 - Small breast
- Left sided breast cancer patients
- Smokers, severe COPD
- Approximately 75% of patients at SSCBC undergoing post-lumpectomy breast radiotherapy are treated in prone position

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Prone Breast Planning at SSCBC

- Protocols used
- OAR & Targets
- Goals

RTOG 1005 & 1304

Organs at Risk

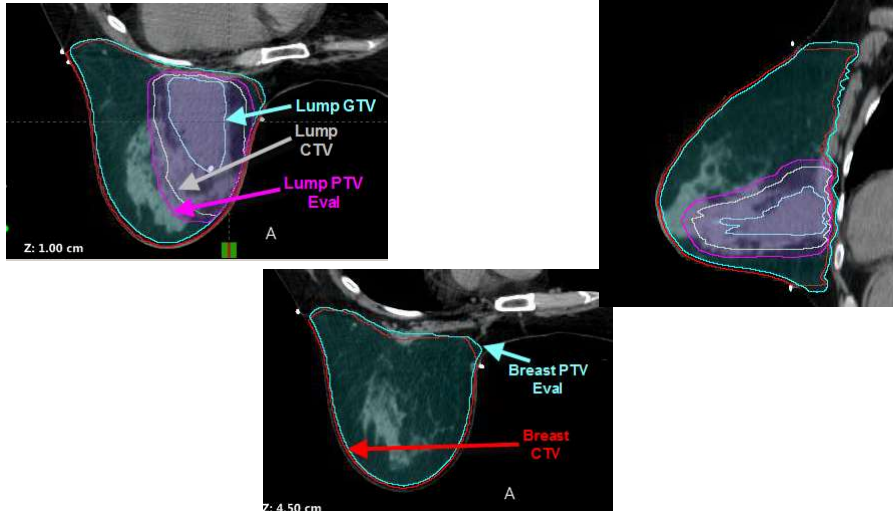
- Heart
- Left Lung
- Right Lung
- Contralateral Breast
- Sternum
- Thyroid

Physician Drawn Targets

- Breast CTV
- Breast PTV
- Breast PTV Eval
- Lumpectomy (Lump) GTV
- Lump CTV
- Lump PTV
- Lump PTV Eval

*In Prone (and Supine DIBH) at SSCBC the CTV to PTV expansion is reduced to 5mm due to limited chestwall motion

Targets Contoured:



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Constraints & Goals

RTOG 1005 & 1304

	Ideal	Acceptable
Breast PTV Eval	95%/95%	90%/90%
Lump PTV Eval	95%/95%	90%/90%
50% Breast PTV Eval	<108%	<112%
VBreast Receiving Boost Dose	30%	35%
Heart Mean	<400cGy	<500cGy
Lung V20	15%	20%
Contra Breast Max	<300cGy	<330cGy

SSCBC

	Ideal	Acceptable
Breast PTV Eval	95%/95%	90%/90%
Lump PTV Eval	100%/100%	100%/95%
50% Breast PTV Eval	<108%	<112%
VBreast Receiving Boost Dose	30%	35%
Heart Mean	<200cGy	<200cGy
Lung V20	10%	15%
Contra Breast Max	<300cGy	<330cGy

*Boost (when indicated) & Whole Breast planned simultaneously in **Prone** Position.
 Constraints & Goals evaluated in Plan Sum.

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Hypofractionated/Canadian Fractionation

- SSCBC Guidelines for Hypofractionation
- Stage 1 or 2
- No Lymph Nodal Involvement
- Hormone Receptor positive
- 60+ years (sometimes women 50+ years)
- No prior chemotherapy

Standard Fractionation
2.0Gy * 25 FX = 50.0 Gy

VS.

Hypofractionated Prescription:
2.66Gy * 16 FX = 42.56Gy

Prone with Boost

- Boost is planned at time of Initial plan
- Boost is in **Prone** position as well
- “Simultaneous Boost” hotspot placed in the Lump PTV Eval
- Plan evaluated in Plan Sum
- “Ski slope”
 - V54



Emergence of Accelerated Partial Breast Irradiation (APBI)

- Breast failures occur at, or near location of the original lesion in 75-90% of cases for Whole Breast Irradiation (WBI)
- Major therapeutic effect of WBI may actually be at the surgical site

Therefore:

- APBI delivers radiation to adjacent 1-2cm of Breast tissue at highest risk for recurrence instead of targeting entire breast



Rationale for Post-Surgery APBI

- Shortening overall treatment course
- Reducing radiation dose to lower risk ipsilateral breast tissues
- Decrease Toxicity
- Improving overall utilization of breast conserving therapy
- *Can be delivered via Brachytherapy or 3D Conformal Therapy (3DCRT)*



Post-Surgery APBI Fractionation Schedule

- 3-6 Gy
- 5-10 Fractions
- Delivered 1-2 times a day
- Over 5-8 day treatment course
- *APBI Post-Surgery*

Patients Suitable for Post-Surgery APBI

- Women
- Over 50 years of age
- Undergone successful lumpectomy with negative surgical margins and sentinel node biopsy confirming Stage I
- Hormone responsive disease
- Committed to completing anti endocrine therapy

Post-Op APBI

- Delivering Post-op radiation disrupted blood & lymph supply
 - May be suboptimal in terms of radiosensitivity
 - Limits the opportunity to observe radiation-induced tumor response
- MRI important tool for measuring extent of disease prior to neoadjuvant chemo and response after
 - Whether MRI correlates with radiation response may be similarly identified

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Question Time!!

- Woman
 - 65 years old
 - Stage IA (cT1bcNo)
 - ER+/PR+/HER 2-
 - No Lumpectomy
 - How would you treat her?
- A. 25FX Total Dose 50Gy
 - B. 16FX Total Dose 42.56Gy
 - C. 15FX Total Dose 40.0Gy
 - D. Post Surgery APBI
 - E. None of the above

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Answer

- A. 25FX 2.0Gy TD = 50Gy
- B. 16FX 2.66Gy TD = 42.56Gy
- C. 15FX 2.67Gy TD = 40.0Gy
- D. Post Surgery APBI
- E. **NONE OF THE ABOVE**

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Pioneering Treatment Early Stage Breast Cancer at OSU

Protocol OSU 13282 – Feasibility of assessing Radiation Response with MRI/CT Directed **Pre-Op** Accelerated Partial Breast Irradiation in the **Prone** Position for Hormone Response early stage Breast Cancer

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Rationale for *Pre-Surgery* APBI (OSU 13282)

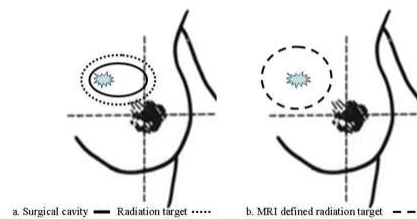
- **Primary Hypothesis:**
 - *MRI will improve targeting, planning and delivery, and that MRI features can be identified to correlate with pathologic radiation response. Identification of a poor radiation response group will permit investigation of novel treatment approaches (e.g. dose escalation and/or radio sensitizers)*

Rationale for *Pre-Surgery* APBI (OSU 13282)

- **Primary Goal:**
 - *Assess the technical feasibility and associated radiation-surgical toxicity of a novel method of delivering APBI preoperatively*
- MRI highly sensitive for detecting cancer of the breast and for response to treatment
 - Therefore, radiation may be more ideally targeted based on MRI-defined preoperative disease location versus surgical cavity location

Rationale for *Pre-Surgery* APBI (OSU 13282)

- Inherent targeting for accuracies for the lumpectomy cavity
- Unknown radiation response
 - Illustrated below, this cavity may not necessarily or accurately direct placement of the radiation field optimally toward the highest risk area of the breast around the tumor




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Eligibility for *Pre-Surgery* APBI (OSU 13282)

- Women
- Over 50 years of age
- Core Biopsy proven hormone responsive Breast Cancer
- Unifocal Breast Cancer
- Able to undergo MRI Imaging with contrast
- No Prior malignancy (<5 years prior to study entry)
- No collagenous disease
- No previous Hormonal Therapy, Radiation or Chemo for current Breast Cancer
- Life expectancy 2+ years

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Protocol OSU 13282

- CT scan with patient in prone position
- MRI scan with patient in same prone position as CT
 - MRI & CT fused together
- Dosimetrist contours OAR
- Physician contours GTV from fused MRI/CT
 - GTV: MRI defined tumor + 10mm margin
 - CTV: uniform expansion of GTV of 15mm
 - PTV: 5mm expansion of CTV
 - Excluding chest wall musculature and cropped 5mm from skin

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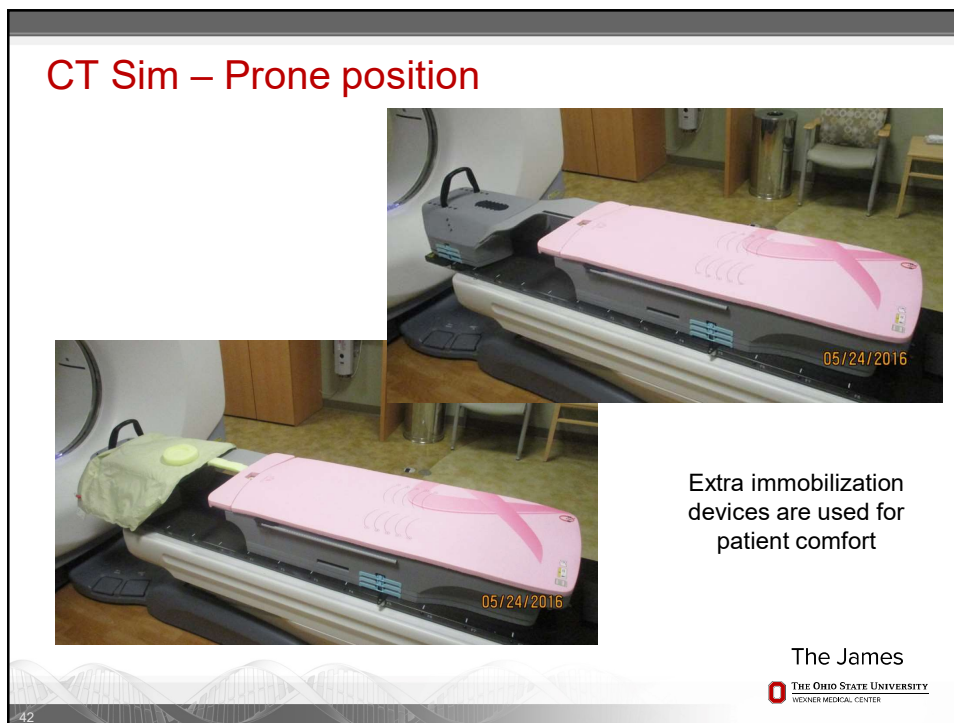
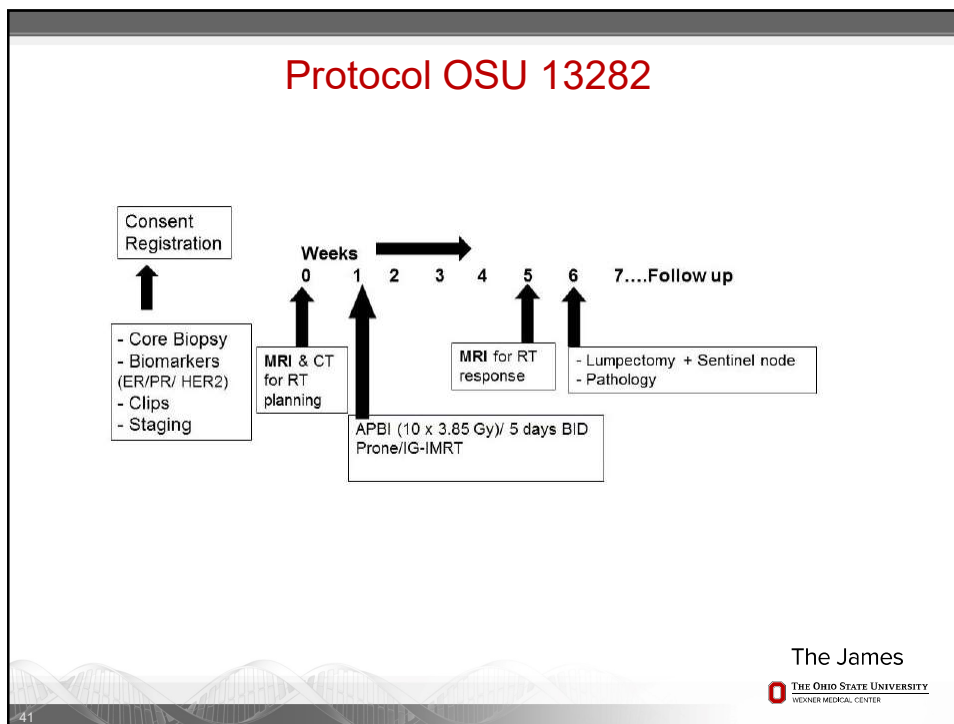
Protocol OSU 13282

- 33 Patients
 - Cohort 1: 3 patients to verify flow between MRI and CT
 - Cohort 2: 30 patients receive radiation treatment
- Prescription Dose = 38.5Gy in 10Fx, 3.85Gy BID, separated by at least 6 hours, delivery in no less than 5 and no more than 10 business days
- Follow up MRI completed 4 weeks post radiation and before surgical resection to assess response

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CT Prone Positioning

- Index Immobilization
- Patient starts low on hands & knees before laying down. Inframammary fold should fall just above the inferior opening of the insert
- Smoothing of the belly tissue may be needed
- Elbows bent in Vac-bag to ensure arm reproducibility & comfort. Location of headrest is marked
- Contra breast should be gently pulled “down & out” and rest on the sternal sponge
 - Sponge placed under contra breast (if needed)
- Head turned toward the contra side
- Back should be as flat as possible with shoulders relaxed



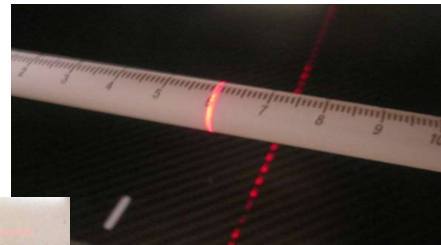
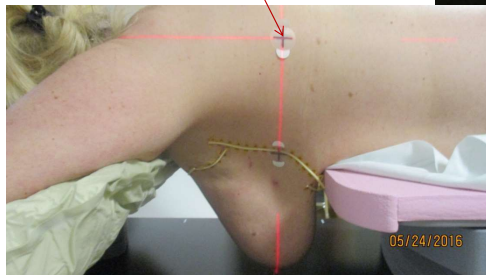
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5 Tattoos

Ipsilateral
Tattoo



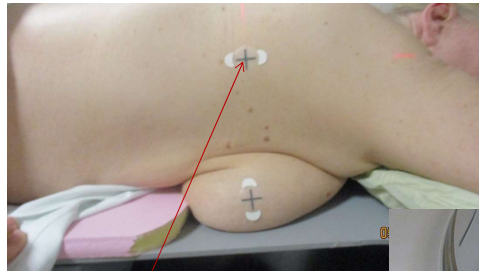
Board number on
index bar in line
with mid-nipple or
other designated
breast mark

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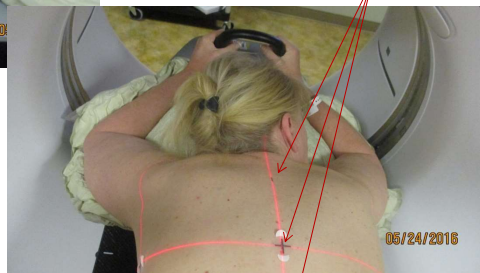
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5 Tattoos (cont'd)



Contralateral Tattoo



3 PA Tattoos

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Pre-Surgery APBI – Tricks & Tips



Sans Sponge

With Sponge



*Note the position of the contralateral Breast

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Pre-Surgery APBI – Tricks & Tips

- Manufactured “Test” MRI bore device

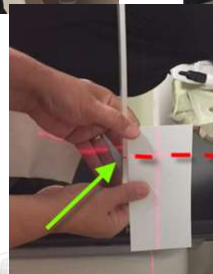


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Pre-Surgery APBI – Tricks & Tips



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MRI Prone Positioning

- MRI scan with patient in same prone position as CT
 - MRI & CT fused together
- MRI times: ~18 minutes to complete 4-5 series for this protocol
 - Normal Breast MRI's are 6 series for a total of ~25min
- Extremity coil is used in MRI
 - Taped to immobilization for stability
- Contrast IS used during MRI
 - But not all series



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MRI Prone Positioning



Notice how tight her elbows are in the Vacbag. This is to allow clearance for MRI



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MRI



Chosen MRI Series: MR t1_f13d FS C+

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Detailed description: This slide displays a breast MRI scan. The word 'MRI' is written in red in the top left corner. The central image is a grayscale MRI scan of a breast, showing internal tissue structures. A red arrow points to a bright, well-defined lesion in the lower right quadrant of the breast. A green crosshair is visible in the upper right area of the scan. Below the scan, the text 'Chosen MRI Series: MR t1_f13d FS C+' is written in red. The bottom right corner features the logo for 'The James THE OHIO STATE UNIVERSITY WEXNER MEDICAL CENTER'. The bottom left corner has the number '51'.

OSU 13282; Work flow after CT & MRI

- Radiologist reviews the MRI series
 - Chooses best series
- Dosimetrist fuses chosen MRI series with CT Sim
 - Physicist reviews fusion
- Rad Onc draws in MRI GTV, GTV, and expansions
 - Radiologist reviews targets if necessary
- Dosimetrist creates plan

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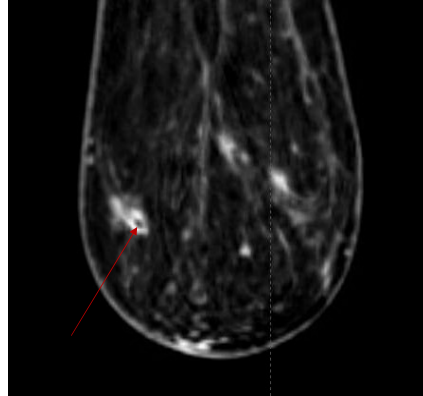
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Detailed description: This slide is a text-based workflow diagram. The title 'OSU 13282; Work flow after CT & MRI' is in red. Below the title is a bulleted list of five steps in the workflow. The bottom right corner contains the logo for 'The James THE OHIO STATE UNIVERSITY WEXNER MEDICAL CENTER'. The bottom left corner has the number '52'.

CT/MRI Images

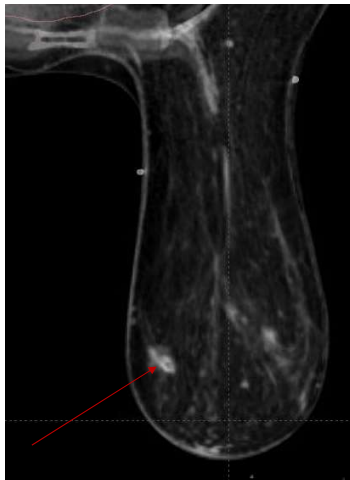


CT Image

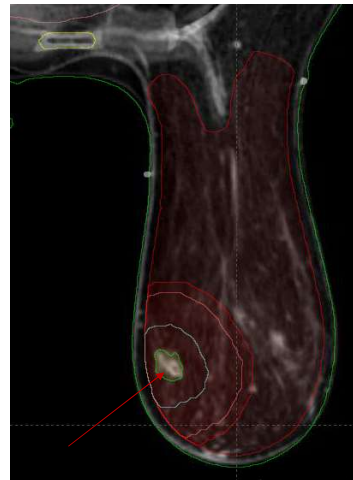


MRI Image

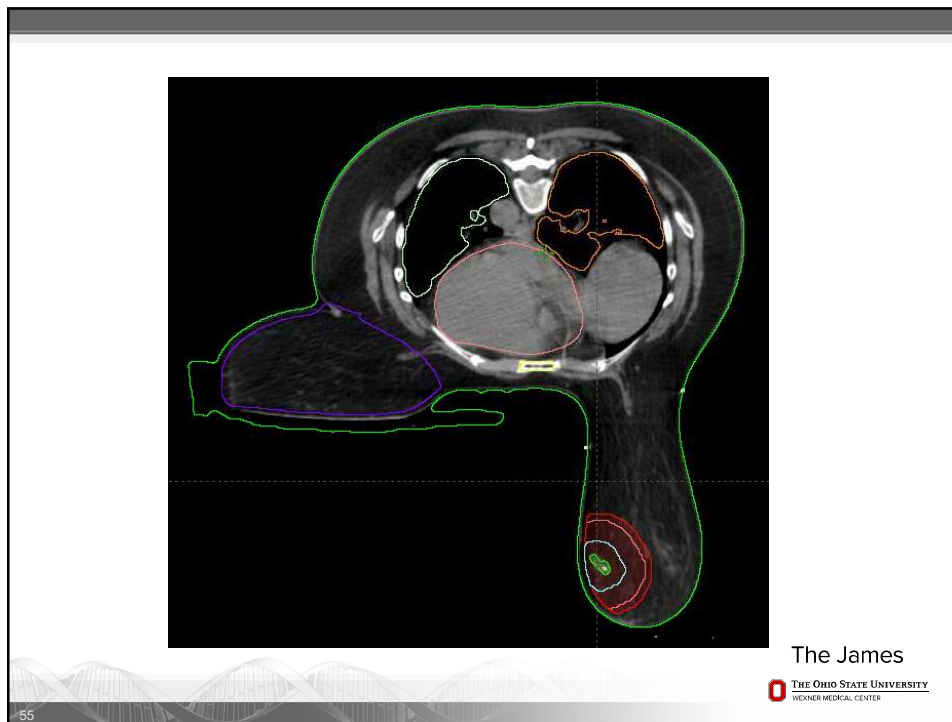
CT/MRI Images Fused



CT/MRI Fused



CT/MRI Fused with targets on



Protocol OSU 13282 – Planning Objectives

- PTV
 - D99 \geq 95%
- Uninvolved normal breast
 - V19.25Gy < 50%
 - V38.5Gy < 30%
- Contralateral breast
 - D0.03cc < 1.15Gy
- Ipsilateral lung
 - V11.55Gy < 15%
- Contralateral lung
 - V5.78Gy < 5%
- Heart (right-sided lesions)
 - V1.93Gy < 5%
- Heart (left-sided lesions)
 - V1.93Gy < 40%

Note: V19.25Gy = Volume receiving 19.25Gy of the prescribed dose or more

OSU 13282

Organs at Risk

- Heart
- Left Lung
- Right Lung
- Contralateral Breast
- Thyroid
- Sternum

Physician Drawn Targets

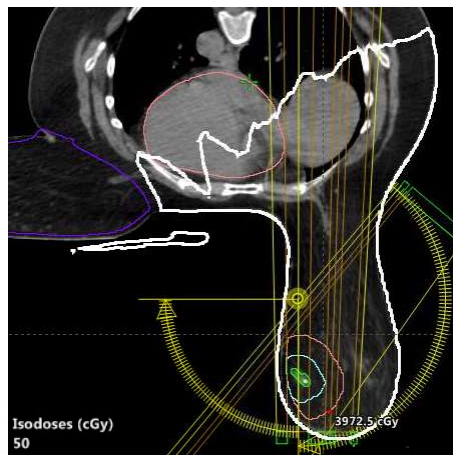
- MRI GTV
- GTV
- CTV
- PTV

*Dosimetry guidelines from the NSABP B39/RTOG 0413 study established for 3D conformal RT with patient in supine position



Planning OSU 13282

- Where do we start?
- Attempted VMAT
- This lead to too much uninvolved Breast dose, Contra Breast dose, and Heart dose
- Moved to Static IMRT Planning
- Which beam angles for IMRT??



Use Normal Tissue Objective Priority: 100 Define Settings...

Objective	Volume [cc]	Points	Resolution [mm]
<input checked="" type="checkbox"/> GTV	25	8993	2.23
Upper	0.0	4050.0	3.00
Lower	100.0	3850.0	3.00
<input checked="" type="checkbox"/> MRI GTV	2	3435	1.00
Upper	0.0	4050.0	3.00
Lower	100.0	3800.0	3.00
<input checked="" type="checkbox"/> BODY	28300	654083	4.50
Upper	0.0	4050.0	3.00
<input checked="" type="checkbox"/> Contra Breast	1757	147694	3.00
Upper	0.0	75.0	3.00
<input checked="" type="checkbox"/> Heart	461	45420	3.00
Upper	0.0	100.0	3.00
<input checked="" type="checkbox"/> opti ptx	139	20786	3.00
Upper	0.0	4000.0	3.00
Lower	30.0	3950.0	3.00
Lower	98.0	3950.0	3.00
<input checked="" type="checkbox"/> ring 50	29547	514858	4.50
Upper	0.0	1900.0	3.00
<input checked="" type="checkbox"/> ring 80	26315	522971	4.50
Upper	0.0	3000.0	3.00

Add Upper Objective Add Lower Objective Delete Objective

Dose Volume Histogram

Volume [%] vs Dose [cGy]

Performing GLOBAL optimization...
71/71 fields left

Optimizing ... 0h 0m 17s 0

Calculation Options

Global optimization:
Coplanar

Local optimization:
Powell

Min number of fields: 5
Max number of fields: 9

Edt... OPTIMIZE

Continue to Optimization OK Cancel Apply

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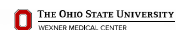
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Planning OSU 13282

Beams used



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Planning OSU 13282

The screenshot displays a radiotherapy planning interface. On the left, a table lists target and OAR volumes with their respective constraints:

ID/Type	Vol[cm ³]	Vol [%]	Dose [cGy]	Actual Dose [cGy]	Priority	gEUD a
_GTV	24.7					
Upper		0.0	4950	190	x	
Lower		100.0	3850	100	x	
_MRI GTV	1.7					
Upper		0.0	4950	190	x	
Lower		100.0	3850	100	x	
opti ptx	139.2					
Upper		0.0	4000	80	x	
Upper		0.0	3950	80	x	
Lower		98.0	3850	80	x	
Lower		100.0	3750	80	x	
BODY	28379.6					
Upper		0.0	4850	300	x	
Contra Breast	1757.4					
Upper		0.0	75	50	x	
Heart	460.7					
Upper		0.0	100	70	x	
ring 50	20946.7					
Upper		0.0	1900	200	x	

The DVH plot shows Volume (%) on the y-axis (0 to 100) and Dose [cGy] on the x-axis (0 to 3000). A 3D visualization of the patient's anatomy is shown on the right, with various contours and dose distributions overlaid. The text 'The James THE OHIO STATE UNIVERSITY WEXNER MEDICAL CENTER' is visible in the bottom right corner.

Protocol OSU 13282

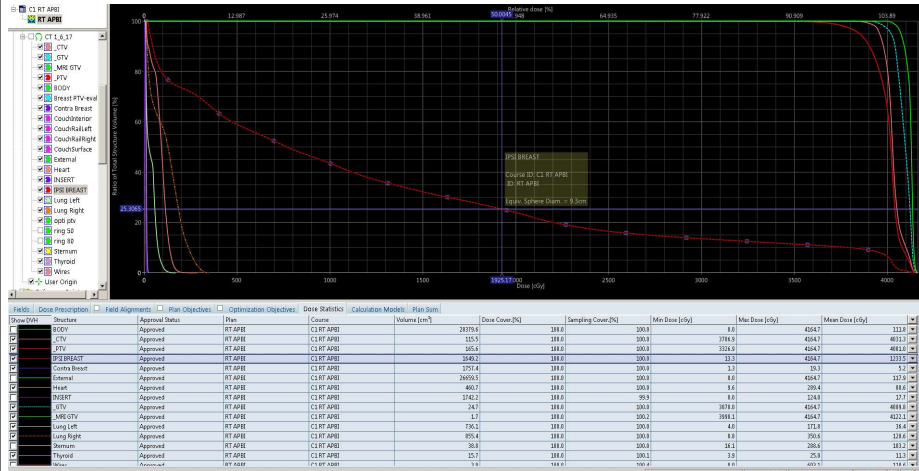
The screenshot displays a radiotherapy planning interface. On the left, a list of fields and OARs is shown. The 3D visualization shows the patient's anatomy with the treatment plan overlaid. A table at the bottom lists the field parameters:

Group	Field ID	Technique	Machine/Energy	MLC	Field Weight	State	Calculation Models	Plan Sum	Cough Rtn
<input checked="" type="checkbox"/>	6 G200	STATIC-1	TrueB2 - 6X	Dose Dynamic	1.000	Varian IEC	200.0	0.0	0.0
<input checked="" type="checkbox"/>	7 G220	STATIC-1	TrueB2 - 6X	Dose Dynamic	1.000	Varian IEC	220.0	0.0	0.0
<input checked="" type="checkbox"/>	8 G240	STATIC-1	TrueB2 - 6X	Dose Dynamic	1.000	Varian IEC	240.0	0.0	0.0
<input checked="" type="checkbox"/>	9 G270	STATIC-1	TrueB2 - 6X	Dose Dynamic	1.000	Varian IEC	270.0	0.0	0.0
<input checked="" type="checkbox"/>	1 G50	STATIC-1	TrueB2 - 6X	Dose Dynamic	1.000	Varian IEC	50.0	0.0	0.0
<input checked="" type="checkbox"/>	2 G75	STATIC-1	TrueB2 - 6X	Dose Dynamic	1.000	Varian IEC	75.0	0.0	0.0
<input checked="" type="checkbox"/>	3 G100	STATIC-1	TrueB2 - 6X	Dose Dynamic	1.000	Varian IEC	100.0	0.0	0.0
<input checked="" type="checkbox"/>	4 G160	STATIC-1	TrueB2 - 6X	Dose Dynamic	1.000	Varian IEC	160.0	11.0	0.0
<input checked="" type="checkbox"/>	5 G180	STATIC-1	TrueB2 - 6X	Dose Dynamic	1.000	Varian IEC	180.0	15.0	0.0

The text 'The James THE OHIO STATE UNIVERSITY WEXNER MEDICAL CENTER' is visible in the bottom right corner.

- Met ideal constraints and objectives
- 9 field static IMRT
- VMAT attempted
- Unable to meet contralateral breast max dose (D0.03cc < 1.15Gy)

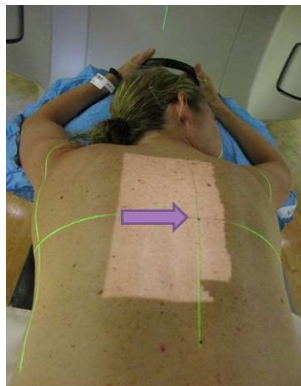
Protocol OSU 13282



Well under protocol requirements for amount of normal breast tissue receiving 50% and 100% of prescription dose

VSim & Treatment Setup

- Patient adjusted Right to Left, Sup and Inf, and rolled to align tattoos to lasers.



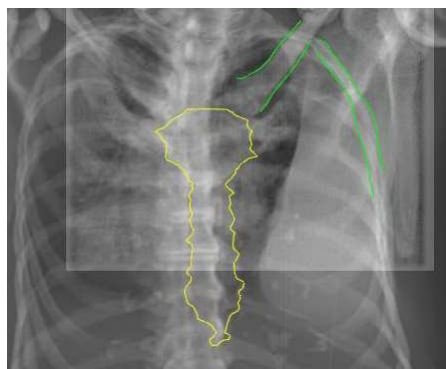
PA and Lateral SSD is checked

Pre-Op APBI Imaging

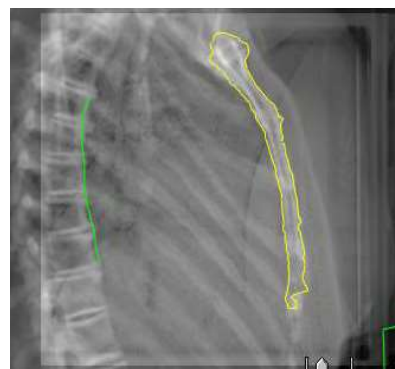
- V-Sim Always performed with physician present
- Orthogonal kV pairs taken for isocenter verification
- Shifts made (if necessary)
- CBCT taken to finalize isocenter verification
- PA, lateral, and treatment SSDs are verified

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Pre-Op APBI Imaging – Orthog's



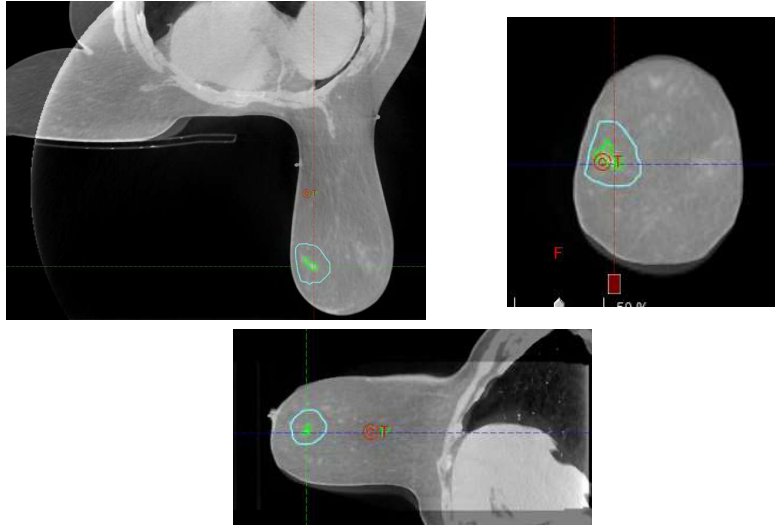
kV PA Setup



kV RLat Setup

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Pre-Op APBI Imaging - CBCT



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Pre-Op APBI Post Radiation

- Chemotherapy
- Anti-endocrine Therapy
- Lumpectomy and Sentinel node Biopsy
- Follow-Up MRI

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Key Components for Successful Prone Treatments

- Integrated team of specialists
- Full patient compliance and understanding
- Proper equipment
- Established Policy & Procedure



Image Source:
<http://www.engagingothers.com/2012/02/are-you-putting-the-me-in-team/>

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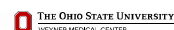


References/Contributions

- Dr. Julia White
- Dr. Jose Bazan
- Tina LaPaglia (Lead Therapist SSCBC)
- Dominic DiCostanzo
- Kristen Krupela

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Thank You

To learn more about Ohio State's cancer program, please visit cancer.osu.edu or follow us in social media:



Lee.Culp@osumc.edu

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Just a reminder to get a breast exam while you're visiting the doctor's for the cold you think is Ebola.

somee cards



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please

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