

Long Beach Medical Center

Miller Children's & Women's Hospital Long Beach

Prone Breast Treatments Using SGRT: Accuracy, Impact, Workflows

Accuracy, Impact, Workflows

Disclosures

- I have no financial interests or disclosures
- This presentation is a collection of protocols, studies, white papers, data, opinions, and anecdotes



Accuracy, Impact, Workflows

Learning Objectives

At the end of this presentation, the viewer will be able to:

- Explore the feasibility of SGRT for prone breast treatments
- Examine the accuracy of SGRT on prone breast setups
- Evaluate the dosimetric impact of SGRT vs IGRT
- Recommend SGRT workflows for prone treatments for their facility



Status Quo: Supine Breast Treatments



DIBH Left Breast Setup:

Not feasible for this patient

Nowhere to put marks/tattoos Breast not reproducible

Edge field size limitations OARs exceed tolerance



Avant-garde: Prone Breast Treatments

Prone Breast Radiotherapy

- Allows for better dose homogeneity
- Reduces skin folds
- Breast position is more reproducible
- Breast is increased distance from OARs
- Respiratory motion significantly reduced





Avant-garde: Prone Breast Treatments

Indications for Prone Breast Radiotherapy

• Patients with large, pendulous breasts

• To reduce toxicity

Patients with small breasts

• To pull the breast tissue away from the chest wall

• Left-sided breast cancer patients who can not tolerate DIBH

- Due to compliance, lymphedema, pain
- Patients with respiratory comorbidities such as COPD or smokers
 - Reduces heart and lung dose



Avant-garde: Prone Breast Treatments

Contraindications for Prone Breast Radiotherapy

- Left Anterior Descending Artery (LAD) dose can be significantly higher in the prone position versus supine
 - Volume of LAD dose receiving V15Gy is a predictor of risk for Major Adverse Cardiac Events (MACE)
- Nodal volumes are difficult to treat prone
- Prone position can exacerbate neck pain
- Requires prone breast board
- There is a learning curve to setting up prone
 - Not a common procedure
 - Not intuitive





Ensuring a Robust Setup for Daily Success

CT Prone Positioning Tips

- Wires on scar, borders
- Sternum rests on board to prevent rolling
- Verify there's no rolling into the opening
- Guide contralateral breast away
- Smooth belly tissue away from opening
- Arms are bent comfortably
- Ensure back is as flat and neutral as possible
- No towels/sheets covering area to be scanned
- Index and document everything!





Ensuring a Robust Setup for Daily Success

Treatment Planning Tips:

- Delineate couch and support structures
- Ensure the heart is blocked, utilize backup jaws
- 2-3 cm of flash
- In/Out laser lines up with nipple or other notable landmark
- Mindfulness of iso position:
 - Lateral SSD considerations
 - Gantry clearance
 - Camera pod visibility
- Helpful hints for plan printout:
 - 3D surface render
 - Table vert
 - Lateral offset





Ensuring a Robust Setup for Daily Success

Verification Simulation Tips:

- Couch is initially at zero position left/right, no angular adjustments
- Patient is adjusted on the breast board into treatment positions
- Drive couch to planned position
- Gantry 180 (180.1 for left breasts)
- SGRT to verify patient 6DOF position
 - AlignRT postural camera to verify arms, breast position
 - ROI selection is crucial
 - Verify SGRT with imaging
- Imaging/SGRT Reference











Ensuring a Robust Setup for Daily Success

Using SGRT for Setup:

Things to consider:

- ROI selection is crucial
 - Should represent treatment area
 - Contain topographic landmarks to ensure a unique solution
 - ROI sufficiently large to prevent occlusion by gantry
 - ROI sufficiently small to prevent loss in temporal resolution
 - Will ultimately differ slightly per patient based on their anatomy
- Surface ROI needs to be correlated to internal structures via imaging
 - Ground truth reference
 - Treatment area-dependent

Includes both sides, as well as center, to capture all 6 degrees of freedom











Workflows: Troubleshooting Discrepancies

Troubleshooting Tips:

Potential causes of discrepancy between x-rays and SGRT:

- 1st verify immobilization devices
 - Reproducible setup and documentation is important and the most likely cause of errors
- 2nd verify ROI robustness
 - Is it occluded by the gantry, including sheets/towels, subject to respiratory motion?
- 3rd check for any potential anatomic changes
 - Weight gain/loss, changes in swelling/edema
- 4th verify the recent calibrations/QA
 - Any changes to the pods for any reason



Practical Radiation Oncology Guidelines on Positioning and Imaging

Practical Radiation Oncology (2018)



Radiation Therapy for the Whole Breast: An American Society for Radiation Oncology (ASTRO) Evidence-Based Guideline

31 ASTRO WHOLE BREAST IRRADIATION GUIDELINE

Patient positioning and position verification/image guidance

Statement KQ4E: Patients should be positioned considering the reproducibility of the breast for treatment. Skin folds should be unfolded to the extent possible. For patients with a large breast size, prone positioning may be used to further minimize dose to normal tissues. Regardless of the positioning method, care should be taken to ensure that the contralateral breast is not in the treatment fields.

- Recommendation strength: Strong
- Quality of evidence: High
- Consensus: 100%

Statement KQ4F: When designing the frequency and type of imaging, imaging of the treatment beam ports may be used to minimize dose to normal tissues such as the heart. For patients with significant daily positioning variations, daily imaging may be used. Doses are lowest with kilovoltage (kV) planar techniques but the appropriate imaging method depends on the localization needs for the patient.

- Recommendation strength: Conditional
- Quality of evidence: Low
- Consensus: 93%

"Regardless of the positioning technique, additional factors affecting patient position are the patient's comfort and the length of time on the treatment table."



Practical Radiation Oncology Guidelines on Positioning and Imaging

Practical Radiation Oncology (2018)



Radiation Therapy for the Whole Breast: An American Society for Radiation Oncology (ASTRO) Evidence-Based Guideline

31 ASTRO WHOLE BREAST IRRADIATION GUIDELINE

When deciding on which imaging technique to use, the ability to confirm the position of the breast should be considered along with the dose to normal tissues. The dose to the heart from imaging can be reduced by using ports of the tangential fields which exclude the heart rather than using orthogonal imaging which may include a portion of the heart. Video-based systems are sometimes used for daily patient setup and can be supplemented with once a week imaging. Doses are lowest with kV planar EPID when compared with planar megavoltage (MV) methods and cone beam CT (CBCT). Imaging dose to the heart, ipsilateral lung, and contralateral breast can be restricted by limiting the imaging field of view. When there is an advantage to using CBCT rather than a planar

"The frequency of imaging should be tailored to what is best to reproducibly set up the patient. For many patients, weekly imaging may be appropriate with more frequent imaging being required for patients who do not set up within 5 mm."



Prone Breast Treatments Using SGRT: Impact of Imaging

>5mm setup offset can significantly increase:

- Mean heart dose
- LAD V15 volume
- Lung V20 volume
- Mean lung dose

Ultimately, the potential dosimetric impact from imaging doses are less than consistently misaligning the patient through systematic errors

- Surface still needs to be correlated to internal structures via imaging
 - Frequency = ??





To reduce imaging dose, it is important to reduce the heart/LAD dose as much as possible in the sim/planning phase

MemorialCare,

Prone Breast Treatments Using SGRT: A New Paradigm?



Decreased dependence

Thoughts to ponder:

- Can we see what we need to in our images?
- Are we doing anything with the images we're taking?
- Did we have the best setup to yield the best plan?



Prone Breast Treatments Using SGRT: Putting it all together: Accuracy, Impact, Workflows





						average shifts [cm]			
	modality	v-sim time [min:sec]	average setup time [min:sec]	average tx time [min:sec]	# ports	vert	long	lat	rot
patient A	imaging only	43:00	11:30	10:00	28	-0.30	0.41	0.27	0.00
patient B	SGRT	38:00	12:09	7:30	<u> </u>	-0.43	-0.07	0.09	0.00
	difference	-12%	6%	-25%	-29%	0.12	0.49	0.18	0.00



Prone Breast Treatments Using SGRT: Putting it all together: Accuracy, Impact, Workflows





For the patient where SGRT was used for setup, vs OBI alone, there was a 25-30% reduction in the number of ports and ~20% reduction in adjusting of the patient prior to beam-on



Putting it all together: Accuracy, Impact, Workflows

Only reviewing couch x-y-z shifts can mask the fact that SGRT is helping to compensate for yaw-roll-pitch as well.

Consider the patient's 'pivot point' with respect to their ROI location

When determining departmental imaging/re-imaging protocols, consider the ground-truth reference and base the thresholds on that









Summary

- Patient posterior surface does correlate to treatment area
 - Robust setup
 - Documentation
- Important to set imaging protocols staff feels comfortable with
 - SGRT allows for verification of imaging shifts
 - Can reduce # of images/repeat images and overall treatment time
- SGRT can allow for a tattoo-/mark-free workflow
- Entire clinical team needs to be involved
 - Each step in the workflow affects the downstream process



Accuracy, Impact, Workflows

Learning Objectives Met:

- ✓ SGRT for prone breast treatments is feasible
- ✓ SGRT on prone breast setups is accurate
- ✓ SGRT vs IGRT alone allows for less imaging and reduced OAR doses
- ✓ SGRT for prone treatments can fit into current workflows



Thank You!



Long Beach Medical Center

Miller Children's & Women's Hospital Long Beach

Prone Breast Treatments Using SGRT: References

- Al-Hallaq, HA, Cerviño, L, Gutierrez, AN, et al. AAPM task group report 302: Surface-guided radiotherapy. Med Phys. 2022; 49: e82–e112. https://doi.org/10.1002/mp.15532
- Bastita et al, "Clinical paradigms and challenges in Surface Guided Radiation Therapy: Where do we go from here?" Radiotherapy and On cology, 153: 34-42, 2020
- Poitevin-Chacón A, Chávez-Nogueda J, Prudencio RR, Fernández AC, Laguna AR, Linares J, Martínez JC. Dosimetry of the left anterior descending coronary artery in left breast cancer patients treated with postoperative external radiotherapy. RepPract Oncol Radiother. 2018 Mar-Apr;23(2):91-96. doi: 10.1016/j.rpor.2018.01.003.Epub 2018 Feb 12.PMID:29681771; PMCID: PMC5908386.
- Atkins, K, et al. Mean Heart Dose Is an Inadequate Surrogate for Left Anterior Descending Coronary Artery Dose and the Risk of Major Adverse Cardiac Events in Lung Cancer Radiation Therapy. International Journal of Radiation Oncology, Biology, Physics. 2021 Aug 01; vol 110, issue 5, pp1473-1479. <u>https://doi.org/10.1016/j.ijrobp.2021.03.005</u>
- Freislederer, P., Kügele, M., Öllers, M. et al. Recent advances in Surface Guided Radiation Therapy. Radiat Oncol 15, 187 (2020). https://doi.org/10.1186/s13014-020-01629-w
- Huppert N, Jozsef G, DeWyngaert K and Formenti SC (2011) The role of a prone setup in breast radiation therapy. Front. Oncol. 1:31. doi: 10.3389/fonc.2011.00031
- Csenki M, Újhidy D, Cserháti A, Kahán Z, Varga Z. Radiation dose to the nodal regions during prone versus supine breast irradiation. Ther Clin Risk Manag. 2014;10:367-372. https://doi.org/10.2147/TCRM.S59483
- Mireștean CC, Iancu RI and Iancu DPT (2022) Hypofractionated Whole-Breast Irradiation Focus on Coronary Arteries and Cardiac Toxicity A Narrative Review. Front. Oncol. 12:862819. doi:10.3389/fonc.2022.862819
- Deseyne, P., Speleers, B., De Neve, W. et al. Crawl positioning improves set-up precision and patient comfort in prone whole breast irradiation. Sci Rep 10, 16376 (2020). https://doi.org/10.1038/s41598-020-72702-3
- Yao, S., Zhang, Y., Nie, K. et al. Setup uncertainties and the optimal imaging schedule in the prone position whole breast radiotherapy. Radiat Oncol 14, 76 (2019). https://doi.org/10.1186/s13014-019-1282-4
- McKinnon, R., Christie, D., et al. The prone technique for breast irradiation is it ready for clinical trials? The Breast (2009), Volume 18, Issue 1, pp 30-34. ISSN 0960-9776, https://doi.org/10.1016/j.breast.2008.09.006
- Temme N, Hermann RM, Hinsche T, Becker J-N, Sonnhoff M, Kaltenbom A, Carl UM, Christiansen H, Geworski L, Nitsche M. Radiotherapy of Breast Cancer in Laterally Tilted Prone vs. Supine Position: What about the Internal Mammary Chain? Journal of Personalized Medicine. 2022; 12(4):653. <u>https://doi.org/10.3390/jpm12040653</u>
- Smith, BD, et al. Radiation Therapy for the Whole Breast: An American Society for Radiation Oncology (ASTRO) Evidence-Based Guideline. Practical Radiation Oncology (2018) Supplemental Material. https://www.practicalradonc.org/cms/10.1016/j.prro.2018.01.012/attachment/c299a424-455c-47b4-b36b-58b04ffc824f/mmc1.pdf
- Kügele, Malin & Mannerberg, Annika & Bekke, Susanne & Alkner, Sara & Berg, Lovisa & Mahmood, Faisal & Thornberg, Charlotte & Edvardsson, Anneli & Bäck, Sven & Behrens, Claus & Ceberg, Sofie. (2019). Surface guided radiotherapy (SGRT) improves breast cancer patient setup accuracy. Journal of Applied Clinical Medical Physics. 20. 10.1002/acm2.12700.
- Shah AP, Dvorak T, Curry MS, Buchholz DJ, Meeks SL. Clinical evaluation of interfractional variations for whole breast radiotherapy using 3-dimensional surface imaging. Pract Radiat Oncol. 2013 Jan-Mar;3(1):16-25. doi: 10.1016/j.prro.2012.03.002. Epub 2012 Mar 31. PMID: 24674259.
- Reitz, D., Walter, F., Schönecker, S. et al. Stability and reproducibility of 6013 deep inspiration breath-holds in left-sided breast cancer. Radiat Oncol 15, 121 (2020). https://doi.org/10.1186/s13014-020-01572-w



Prone Breast Treatments Using SGRT: Extra Documents

Items used to create custom phantom:



Sample workflow:



