

## IMRT BREAST PROCEDURES – Beam Split Technique

### GOALS:

1. Target Coverage: Goals are on the 'Breast IMRT – DVH Results and Goals' form.
2. Homogeneity within the PTV Eval:  $V_{105} \leq 1\%$  or  $V_{105} < 1$  cc (per physician).
3. Normal Tissue Sparing: Goals for the ipsilateral lung and heart are on the 'Breast IMRT – DVH Results and Goals' form.

### STEPS

1. The physician writes the prescription and specifies whether the case will be 'uniform-dosed' or 'differentially dosed.'
2. Dose Grid
  - a. Place the dose grid so that it encompasses the entire field, the entire ipsilateral lung with margin, and the entire heart (for left breast cancers.) It is not necessary to include both lungs and doing so will slow calculation speed.
  - b. Set the size of the dose grid to 3 mm.
3. Beam Creation
  - a. If the case was 'CT-simmed,' the beams should already be created and placed on the data set.
  - b. If the case was 'pre-simmed,' the dosimetrist places the tangent beams on the data set with the appropriate gantry angle, field size, and collimator angle (and possible couch kick). Make sure the deep edges of the tangent beams are co-planar.
  - c. The **superior collimator** must be set at a '**whole number**' of centimeters. If it is not, an idiosyncrasy of the planning system will close the most superior MLC on all DMPO segments and create a 'cold' area in the superior portion of the PTV.
  - d. Create DRR's.
  - e. In order to determine the 'maximum separation', measure the separation at two levels: ~2 cm below the superior border and approximately half way between the superior and inferior border (i.e. typically isocenter). For the initial trial, use the % of 15 - 20 MV beam from the table below. A suggested amount for how much to change the % 15 – 20 MV between trials is given and is designed to minimize the number of trials needed to achieve an optimal result.

Maximum Separation	Suggested Starting % 15 - 20 MV	Suggested % to Change Between Trials	Range Used for $V_{105} < 1\%$	Range Used for $V_{105} < 1$ cc
$\leq 20.5$ cm	0	10	0	0
20.6 – 23.0 cm	0	10	0 - 30	0 – 50
23.1 – 27 cm	40	20	20 - 100	40 – 100
> 27 cm	100	20	100	100

4. The appropriate 'hot scripts' are used to create:
  - a. Isodose lines
  - b. ROI list
  - c. Objectives with IMRT parameters included
5. Initial Dosimetrist Contouring
  - a. The dosimetrist auto-contours the ipsilateral lung for all cases.
  - b. The dosimetrist contours the 'Heart Dosi' and creates 'Heart' (*for left breast cases.*)
  - c. Any wire or 'bb' placed on the skin at simulation should be contoured and the density should be set to 0.
6. Initial Physician Review & Contouring
  - a. The physician reviews the dosimetrist's contours.
  - b. The physician contours the lumpectomy cavity (and/or clips) if visible. (Note: The lumpectomy cavity contours can be used for virtual simulation of the boost.)
  - c. Also at this time, the physician reviews and approves the beam placement if it has not already been done.
7. Creation of ROI's
  - a. Dosimetrist creates ROI's using the definitions on the 'Breast IMRT – ROI Definitions and Final Visualization' form.
8. Normalization Point
  - a. The normalization point is placed at approximately mid-separation (left-right) in the plane of the central axis of the beams and ~5 – 10 mm inside the deep edge of the PTV.
9. Prescription for Open Beams
  - a. Enter prescription (daily dose, calc point, and total # fractions) with all of the dose being given through the open beams.
  - b. Use the "Suggested Start % 15 – 20 MV."
  - c. After the dose is calculated, leave the prescription % set to 100%.
  - d. The 'hot voxel' (with the appropriate % of 15 – 20 MV beam) should be < 129% of the prescription dose. If it is not, then move the 'norm point' to a more superficial location.
10. Objectives & Constraints
  - a. If the prescribed dose is not 5000 cGy or 5040 cGy, change doses in the generic breast hot script to the appropriate numbers.
11. The IMRT parameters are already embedded in each of the objective 'hot scripts'
  - a. Optimization type = None
  - b. Allow jaw motion = No
  - c. Max number of segments = 10
  - d. Minimum segment area = 10 cm<sup>2</sup>.
  - e. Leaf/jaw overlap= 0.3 cm.
  - f. Max iterations = 25
  - g. Convolution dose iteration = 4
  - h. Stopping tolerance = 1 X 10<sup>-5</sup>
  - i. Apply tumor overlap fraction? = No
  - j. MLC delivery? = Yes
  - k. Minimum segment MU's = 3
  - l. Compute final dose? = Yes
  - m. Beam splitting overlap distance = 2 cm.

12. Set up the DVH parameters:
  - a. Check the 'Display' box for the following structures so that they will be displayed when DVH's are calculated: PTV, Lung, and Heart (*left cases only*). (NOT LUMPX CAVITY)
  - b. Change Dose Axis Display to Absolute Dose
  - c. Do not check the 'Display' box for the trial that you are about to run. If it is checked, calculation speed will be slower.
13. Isodose lines
  - a. If the prescribed dose is not 5000 cGy or 5040 cGy, change doses in the generic breast 'hot script' to the appropriate numbers.
14. Creating DMPO Beams and Prescription
  - a. Copy the open 6 MV beams.
  - b. In the IMRT Parameters, change the Optimization type to DMPO for these new beams. Leave 'Allow jaw motion' as No.
  - c. Create a new DMPO prescription (daily dose, calc point, and total # fractions). The daily dose for the DMPO beams should be 20% of the total daily dose, and the daily dose in the prescription for the open beams should be changed to 80% of the total daily dose.
15. Click 'Start Optimization'
16. After the plan is complete, set prescription % to 100%.
17. Analyze the results.
  - a. Coverage
    - i. The V90 and V95 (uniform-dosed cases) should meet the appropriate goal. If not, determine where coverage is lacking.
      - (i) If coverage is inadequate **globally**, consider changing the prescription %. Decrease the Open % first, then the DMPO % if needed.
      - (ii) If coverage is inadequate **along the deep border only**, consider creating a new trial and using a new Norm Pt that is placed more posterior.
  - b. 'Hot Spots'
    - i. If 'hot spots' are present near the nipple, make sure that no mistakes were made. This should never happen.
    - ii. If the V105 is **significantly** greater than desired, then create another trial and increase the % of high energy photons as suggested in the Table above (see #3).
    - iii. If the V105 is **minimally** greater than desired, then you can try one of two maneuvers:
      - (i) Increase the prescription % (first on the open beam then on the DMPO beams if needed). This will make the plan **cooler globally**.
      - (ii) Create a new trial and use a new Norm Pt that is slightly more superficial and this will **selectively** make the plan **cooler along the deep border only**.
  - c. Rules for adding high energy photons
    - i. First, change the open beams to mixed beam by incrementally increasing the % of high energy used in open beams. In general, try to use the smallest % of high energy that gives a plan with  $V105 < 1\%$  (or 1cc).

- ii. If all of the dose in the open beams is given with high energy, then change the DMPO beams to high energy.
18. Recalculate the optimal trial in 'cc convolve' (either before or after the physician has approved the plan depending on your confidence level)
19. Fill out a 'Breast IMRT – DVH Results and Goals' form.
20. Create DRRs for the medial and lateral open fields. Include the lumpectomy cavity contours on the DRRs.
21. Present the optimal trial and 'Breast IMRT – DVH Results and Goals' form to the physician. The physician is responsible for visually inspecting each contour to ensure adequate target coverage and adequate sparing of normal tissues.
22. Physician will need to review and sign:
  - a. 'Breast IMRT – DVH Results and Goals' form.
  - b. Simulation note
  - c. Distribution printout – transverse, sagittal, coronal
  - d. Distribution printout – multiple slices. **Print out all slices where the 'Lumpx Cavity' is present so that coverage can be reviewed at chart rounds or by any covering physician.**
  - e. DVH printout [includes PTV, Lung, and Heart (*left-sided cases only*)]
  - f. Open tangent DRR's.
23. Final check by planner
  - a. Machine
  - b. Energy
  - c. # Fraction
  - d. Dose Rate in Impac
  - e. B/up time = 3.0 min
  - f. Dose per field
24. Second check dosimetrist
  - a. PTV Eval expansions
  - b. Grid size

## Breast IMRT – ROI Definitions and Final Visualization

1. Top of Field *(2-field with couch kick and 3,4-field cases only)*
2. BB's
3. Scar Wire
4. Other Wires
5. Skin
6. Lung
7. Heart Dosi Heart contoured to the deep edge of the chest wall *(left breast cases only)*
8. Heart 'Heart Dosi' expanded 0 mm in all directions and then edited by physician *(left breast cases only)*
9. Lumpx Cavity Contoured by physician (if visible)
10. Tangent Vol Give dose through 'open' tangent beams and turn an isodose line that approximates the skin (typically 55% - 60%) into an ROI
11. Irradiated Vol 'Tangent Vol' expanded 0 mm in all directions with 'Lung' and 'Heart Dosi' *(left breast cases only)* as Limiting ROI's. Any remaining tissue that is deep to the deep edge of the chest wall is then removed by hand editing.
12. PTV 'Irradiated Vol' *contracted* 5 mm in all directions
13. TV-??LA5S 'Tangent Vol' *contracted* '??' mm Lateral & Anterior and 5 mm Superior (Note: 'Lateral' = left for left breast and right for right breast)  
The exact value for '??' depends on maximum separation:

Maximum Separation	'??'
≤ 18 cm	20 mm
18.1 – 22 cm	25 mm
22.1 – 30 cm	30 mm
> 30 cm	35 mm

14. Constraint Vol 'Tangent Vol' expanded 0 mm in all directions with 'TV-??LA5S' as Limiting ROI
15. 2D Visualization Make the following changes:  
-Leave 'PTV Eval' = Colorwash. Change 'Lumpx Cavity' to Colorwash.  
-Change all other volumes to None.

## Breast IMRT – Treatment Planning Objectives

<u>ROI</u>	<u>TYPE</u>	<u>DOSE</u>	<u>%VOL</u>	<u>WT</u>
PTV	Uniform Dose	PTV Rx	-----	5
PTV	Min Dose	PTV Rx	-----	1
PTV	Min Dose	95% PTV Rx	-----	1
Constraint Vol	Max Dose	103% PTV Rx	-----	Constraint
Tangent Vol	Max Dose	105% PTV Rx	-----	Constraint
Lung	Max Dose	95% PTV Rx	-----	1
Heart <sup>1</sup>	Max Dose	95% PTV Rx	-----	1

<sup>1</sup> 'Heart' objective should be deleted for right breast cases.

Patient Name and ROC # \_\_\_\_\_

Left breast / Right breast (circle one)

Uniform-dosed / Differential-dosed (circle one)

### Breast IMRT – DVH Results and Goals

Structure and DVH Parameter	Volume	Result	ROC Goal
<b>TARGET</b>			
Breast PTV	cc		
V90	cc	%	≥ 99%
V95 (Goal is for uniform-dosed cases only.)	cc	%	≥ 95%
V105	cc	%	< 1% or < 1 cc (circle one)
<b>NORMAL TISSUES</b>			
Lung	cc		
V20 Gy (tangents only)	cc	%	≤ 15%
Heart V50 (left breast cases only)		cc	≤ 1 cc

Planned by: \_\_\_\_\_ Date: \_\_\_\_\_

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_

Physician Signature: \_\_\_\_\_ Date: \_\_\_\_\_