Published in final edited form as:

Med Dosim. 2018 ; 43(3): 230–236. doi:10.1016/j.meddos.2017.08.011.

Electron Postmastectomy Chest Wall Plus Comprehensive Nodal Irradiation Technique Using Electron Monte Carlo Dose Algorithm

Linda Hong¹, Ase Ballangrud¹, Beryl McCormick², James Mechalakos¹

¹Department of Medical Physics, Memorial Sloan-Kettering Cancer Center, New York, NY10065

²Department of Radiation Oncology, Memorial Sloan-Kettering Cancer Center, New York, NY10065

Abstract

Purpose: For left-sided postmastectomy patients requiring chest wall plus comprehensive nodal irradiation, sometimes traditional techniques such as partial wide tangents or electron/tangents combination are not feasible due to abnormal chest wall contour or heart position or unusually wide excision scar. We developed electron chest wall irradiation technique using Electron Monte Carlo (EMC) dose algorithm that will achieve heart sparing with acceptable ipsilateral lung dose, minimal contralateral lung and breast dose.

Methods: Ten left-sided postmastectomy patients with very challenging anatomy were selected for this dosimetry study. The enface electron fields were designed from a single isocenter and gantry angle with different energy beams using different cutouts that matched on the skin. Smaller energy was used in the central thin chest wall part and higher energy in the medial internal mammary nodes (IMN) area, superior part of the thick chest wall, and/or Axilla area. The electron fields were matched to the photon supra-clavicular field in the superior region. Daily field junctions were used to feather the match lines between all the fields. Electron field dose calculations were done with Monte Carlo.

Results: Five patients' chest wall fields were planned with 6/9MeV combination, one with 6/12 MeV, two 9/12MeV and one 9/16MeV, and one with 6/9/12MeV. Institutional criteria of prescription dose of 50Gy for target volumes and normal tissue dose were met with this technique in spite of the challenging anatomy. Mean heart dose averaged $3.0\text{Gy} \pm 0.8\text{Gy}$. For ipsilateral lung, V20Gy and V5Gy averaged $33.2\% \pm 4.5\%$ and $64.6\% \pm 9.6\%$ respectively. For contralateral lung, V5Gy averaged $5.1\% \pm 5.0\%$. For contralateral breast, V5Gy averaged $3.3\% \pm 3.1\%$.

Conclusions: The electron chest wall irradiation technique using electron Monte Carlo dose algorithm can provide adequate dose coverage to the chest wall, IMNs and/or Axilla nodes while achieving heart sparing with acceptable ipsilateral lung dose, minimal contralateral lung and breast dose.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Keywords

Electron Postmastectomy Chest Wall Irradiation; Electron Monte Carlo Dose Calculations; Heart Sparing

---

Introduction

For node-positive breast cancer patients, post-mastectomy radiation therapy (PMRT) has been shown to reduce the risk of breast cancer recurrence and mortality¹. Treatment planning of PMRT often poses technical challenges because the desired treatment plan will need to cover the chest wall and nodal volume adequately with acceptable dose inhomogeneity but also meet dose constraints to the lungs, heart and contralateral breast. A variety of techniques, including partial wide photon tangents and photon/electron combination, were devised to produce plans depending on variations in patient's anatomical features^{2,3}. More recently, techniques using IMRT or VMAT and proton therapy were also developed⁴⁻⁶.

For left-sided postmastectomy unreconstructed patients requiring chest wall and/or nodal irradiation, sometimes the commonly used partial wide tangents or electron/tangents combination would include an unacceptable amount of lung or heart in the fields due to pectus excavatum chest wall curvature, heart position close to the anterior chest wall or unusual wide excision scar². Since 1990, conformal, CT-based electron beam therapy has been used to treat the chest wall of postmastectomy patients at MSKCC. Mixed energy electron beams with customized bolus were used to ensure adequate skin dose and to tailor the prescription dose to the lung chest wall interface using Electron Pencil Beam (EPB) Dose Algorithms⁷. In 2015, MSKCC adopted the Eclipse Treatment Planning System (Varian) and Electron Monte Carlo (EMC) Dose Algorithm. Clinical plans were recalculated using the EMC dose algorithm. Because of the significant dose difference in lateral scattering and depth penetration due to inhomogeneity or surface curvature from EMC compared with EPB, it was observed that the delivered prescription isodose line usually did not reach beyond the anterior edge of the rib cage including the pectoralis major but not necessarily covering the pectoralis minor. This coverage to the chest wall seemed to be adequate based on our in house low recurrent rate clinical experience and published data^{3,7,8}. We also found that our old EPB planning technique could not be used in Eclipse using EMC to produce plans that meet our clinical established chest wall constraints for target coverage, heart and lung dose constraints. The old technique relied heavily on layers of custom bolus with very limited electron energy variation for any particular patient. In Eclipse, producing detailed custom bolus was not clinically feasible especially with dose distribution calculated using EMC. In fact, we had to implement quite different procedure for design of the electron fields and the utilization of custom bolus so that the EMC plan would meet clinical criteria. This technique utilizes more on electron fields' different energies with much less use of custom bolus. We have not seen published electron chest wall technique for commercially available treatment planning systems using EMC dose algorithm. In this study, we present an electron chest wall irradiation technique using EMC

dose algorithm that will provide adequate IMN node and/or Axilla node coverage while meeting lung constraints and achieving heart sparing.

Materials and Methods

Ten left-sided postmastectomy patients who received radiotherapy using the electron chestwall technique described in reference⁷ were selected for this dosimetry study. Target volumes and normal tissues were drawn based on institutional protocols. Prescription dose was 2 Gy per fraction for a total 50 Gy. Dose calculations were done with Eclipse EMC_11031 for Electron (EMC calculation options were set to be: Accuracy (Statistical uncertainty) 2, Calculation grid size 0.25 cm) and AAA_11031 for photons.

For a patient with the anatomy shown in Figure 1 (a) – (c), the traditional beam arrangements such as partial wide tangents or IMN tag electron field combined with photon tangents would exceed normal heart or lung dose constraints. We used electron fields that matched on the skin to achieve dose conformity to the chest wall. The enface electron fields were designed at extended SSD from a single isocenter and gantry angle but with different energy beams using different cutouts. The outside boundary of the cutout followed the wire placed by the physician during simulation based on palpation and clinical assessment of the patient's anatomy. Lower energy was used in the central thin chest wall part and higher energy was used in the medial IMN area, superior part of the thick chest wall, and/or Axilla area, as shown in Figure 1 (d). Bolus was used for the electron fields to ensure adequate skin dose coverage. For the supraclavicular area, a traditional single oblique photon field was used. Occasionally a posterior axilla boost photon field was also used. The electron fields were matched to the photon supra-clavicular field in the superior region. As shown in Figure 1 (e), a daily 1cm feathering of the junction was used between the electron/photon supraclavicular field and junctions of 0.5cm were used between the electron fields of different energies.

We usually start with the 6MeV and 9MeV combination. A base bolus of 0.5 cm is placed across the chestwall to ensure adequate skin dose. For each electron field, a normalization point at the geometric depth of maximum dose from the data table for that energy is created. The normalization point is placed in the middle of the cutout and at least 1.5 cm away from the cutout edge. The geometric depth of the point should include the bolus thickness. We start by assigning 111.1% to that normalization point so that the 100% (prescription) isodose line corresponds to the 90% depth dose traditionally prescribed in electron therapy. With EMC, we observed that normalization to the traditional isodose level often results in excessive hotspots. Each field's MU can be adjusted slightly to help control the coverage and hot or cold spots, often with the normalization point dose fell between 100% to 111.1%. In general 95% should cover the skin and target volume inside that single field. The 3D dose max should be < 120% for the single field.

The composite dose distribution with all the day1 fields turned on is evaluated based on planning criteria given in Table 1. Cutouts of the fields and or MU of the fields can be slightly adjusted based on the dose distribution for coverage, cold or hot spots. Custom

layers of bolus sometimes can be used to smooth out the patient's surface and tailor the isodose distribution to specific area.

Once the fields were determined, the plan will be separated into Day1 plan and Day2 plan with fields in Day2 plan have junctions with fields in Day1 plan. The Day 2 fields were copied from Day 1 fields with modification for junctions. Same MUs were used in general for Day 1 and its corresponding Day 2 field. As shown in Figure 1 (e), a daily 1cm feathering of the junction was used between the electron/photon supraclavicular field and junctions of 0.5cm were used between the electron fields of different energies.

If our starting combination of 6MeV/9MeV does not provide adequate coverage of the target, different energy combination with different thickness of bolus maybe needed.

Figure 2 illustrates a patient whose anatomy and axillary nodal coverage requirements warranted electron fields with three energies: 6MeV in the thin part of the chest wall, 9MeV in the medial and medial-superior part of the chest wall, and 12MeV in the lateral part of the chest wall plus axillary nodal area.

During planning, the maximum dose from the electron fields only is kept less than 125% of the prescription dose. The maximum dose from the Supraclavicular/Axilla photon fields only would also be less than 125% of the prescription dose. Due to the bulging of isodose lines from the electron field into the photon fields and scattering dose contributions from different fields, the maximum dose from composite plan including all fields are often larger than 140% of the prescription dose (i.e. 70Gy). These hotspots usually are located just superior of the electron/photon field junction. If the global maximum dose is larger than 150%, based on our clinical planning policy, we would do a field-in-field segment for the photon supra-clavicle field to reduce the hotspots around the inferior edge of the field to keep the maximum dose under 150% (i.e. 75Gy). Table 1 shows our clinical planning criteria. These planning criteria are consistent with the criteria of the Alliance A011202 protocol breast cancer patients receiving comprehensive nodal radiation⁹.

For quality assurance purpose, all electron cutouts are checked for accuracy within 2mm. On the day for treatment verification, the planner will go to the treatment room to verify matching fields and bolus placement on the patient. The therapists will make sure the fields are matched daily based on detailed instructions.

Results:

Among these ten patients studied, five patients' chest wall fields were planned using 6/9MeV combination, one using 6/12 MeV, two using 9/12MeV and one 9/16MeV, and one using 6/9/12MeV. If Partial Wide Tangents were used, the central axial distance of the ipsilateral lung from the chest wall would have ranged from 3.4 to 4.4 cm, and the amount of heart would have ranged from 1.3 to 3.8 cm. Eight patients had base bolus of 0.5cm, one patient had base bolus 0.8cm and one had 1.0 cm. Only one patient had one custom layer of bolus on top of the base bolus.

Figure 3 shows the dose distribution and DVH for the patient in figure 2 that used a 6/9/12MeV electron combination to cover the chest wall, IMNs and axilla nodes. For this patient, if partial wide tangents were used, the axial central lung distance would be 3.4cm and the heart distance inside the tangents would be 3.0 cm. With the electron chest wall technique, the heart V30Gy, V25, V20Gy and Mean Dose were 1.6%, 3.1%, 5.2% and 4.29Gy respectively for this patient. For this patient's left lung, V50Gy, V20Gy, V10Gy and V5Gy were 0.2%, 34.1%, 55.5% and 71.6% respectively. For the right lung, V20Gy and V5Gy were 0.8% and 4.7% respectively. For the right breast, V3Gy, V4Gy and V5Gy were 6.3%, 5.4% and 4.7% respectively.

Table 2 shows dosimetric parameters of these ten left chest wall patients. This technique achieved adequate target coverage and acceptable dose inhomogeneity. For CTV_CW, D95% was 44.5 ± 2.6 Gy on average with range from 41.7 to 49.8 Gy; V90% averaged 93.0 ± 2.3 % with range from 90.5 to 96.9% and D05 was 57.6 ± 0.9 Gy on average with range from 56.4 to 59.1 Gy. For EVEN, average D95% was 40.9 ± 1.5 Gy; D90% averaged 43.0 ± 1.2 Gy. For global maximum hotspots in the composite plan of all fields, V65Gy averaged $15.4\text{cc} \pm 8.8\text{cc}$ with range of 4.3cc to 30.1cc; V67.50Gy was $6.0\text{cc} \pm 4.6\text{cc}$ on average with range of 0.4cc to 14.5cc.

As shown in Table 2, despite the challenging anatomy, doses to normal tissues were also meeting institutional criteria with this technique. For heart, V30Gy, V25, V20Gy and Mean Dose were on average $0.5\% \pm 0.6\%$, $1.2\% \pm 1.1\%$, $2.4\% \pm 1.7\%$, and $3.0\text{Gy} \pm 0.8\text{Gy}$ respectively. For ipsilateral lung, V50Gy, V20Gy, V10Gy and V5Gy averaged $0.8\% \pm 0.7\%$, $33.2\% \pm 4.5\%$, $51.6\% \pm 7.6\%$ and $64.6\% \pm 9.6\%$ respectively. For contralateral lung, V20Gy and V5Gy were on average $0.6\% \pm 0.8\%$ and $5.1\% \pm 5.0\%$ respectively. For contralateral breast, V3Gy, V4Gy and V5Gy averaged $4.6\% \pm 3.5\%$, $3.9\% \pm 3.4\%$ and $3.3\% \pm 3.1\%$ respectively.

Discussions:

PMRT treatment planning, especially left side cases, can be very challenging and complex due to a large variation in patients' anatomical features. Varied techniques were established to deal with different planning needs for different targets and normal tissue geometry. Traditionally, partial wide tangential photon fields or electron/photon tangents combinations are used to treat postmastectomy patients^{2,3}. More recently IMRT/VMAT or proton therapy techniques were developed⁴⁻⁶. Different techniques present different dosimetric challenges dependent mainly on the beam arrangements and beam characteristics.

According to the RTOG 3510 pre-trial review of recent studies on heart dose for comprehensive nodal breast cancer treatment¹⁰, photon therapy heart mean dose varied from 4Gy to 9Gy¹¹⁻¹⁵, and proton therapy can achieve heart mean dose less than 1 Gy^{4,14-16}. In 3D-CRT photon therapy techniques, heart mean dose under 5Gy often is difficult to achieve without compromising internal mammary node or chest wall coverage^{11,13,14}. Techniques such as deep inspiration breath hold (DIBH) are used to reduce heart and lung dose for breast treatment. For some patients, DIBH could not be tolerated or did not make difference in the position of the heart relative to the chest wall. With IMRT/VMAT technique, excellent

target coverage and dose homogeneity can be achieved, but in general, even with DIBH, the mean heart dose for left sided cases is above 5Gy^{5,11,14,15}. Research and development has also been active in the area of modulated electron radiotherapy¹⁷⁻¹⁸ and mixed electron-photon radiation therapy optimization¹⁹⁻²⁰ to potentially improve dosimetric parameters for complex chest wall irradiation.

We have demonstrated in this study, that for challenging left sided PMRT with unfavorable anatomy, we were able to achieve heart mean dose under 4Gy and meet target coverage requirements and normal tissue constraints for ipsilateral/contralateral lungs and contralateral breast. With proton therapy not widely available, this electron technique can be used as a form of particle therapy for challenging anatomy. Comparing plans using this technique with non-standard technique such as proton therapy, IMRT/VMAT technique will be a subject of future study.

This technique with EMC dose algorithm has been implemented clinically at our institution since February 2016. Physicians have not reported any adverse effect on any of the patients treated with this technique. Follow up data will be part of a future study.

Conclusions:

For left-sided postmastectomy patients with challenging anatomy, electron chest wall irradiation technique can provide adequate dose coverage to the chest wall, IMNs and/or Axilla node while achieving heart sparing with acceptable ipsilateral lung dose, minimal opposite breast and contralateral breast dose.

Acknowledgements:

This study was presented in part at the 2016 AAPM 58th Annual Meeting in Washington DC.

This research is funded by the MSK Cancer Center Support Grant/Core Grant (P30 CA008748).

References:

1. Ebtcg, McGale P, Taylor C, et al. Effect of radiotherapy after mastectomy and axillary surgery on 10-year recurrence and 20-year breast cancer mortality: meta-analysis of individual patient data for 8135 women in 22 randomised trials. *Lancet* 2014;383:2127–35. [PubMed: 24656685]
2. Pierce LJ, Butler JB, Martel MK, et al. Postmastectomy radiotherapy of the chest wall: Dosimetric comparison of common techniques. *International Journal of Radiation Oncology Biology Physics* 2002;52:1220–30.
3. Kirova YM, Campana F, Fournier-Bidoz N, et al. Postmastectomy electron beam chest wall irradiation in women with breast cancer: a clinical step toward conformal electron therapy. *International journal of radiation oncology, biology, physics* 2007;69:1139–44.
4. MacDonald SM, Jimenez R, Paetzold P, et al. Proton radiotherapy for chest wall and regional lymphatic radiation; dose comparisons and treatment delivery. *Radiation oncology* 2013;8:71. [PubMed: 23521809]
5. Ma J, Li J, Xie J, et al. Post mastectomy linac IMRT irradiation of chest wall and regional nodes: dosimetry data and acute toxicities. *Radiation oncology* 2013;8:81. [PubMed: 23566488]
6. Popescu CC, Olivotto IA, Beckham WA, et al. Volumetric modulated arc therapy improves dosimetry and reduces treatment time compared to conventional intensity-modulated radiotherapy for locoregional radiotherapy of left-sided breast cancer and internal mammary nodes. *International journal of radiation oncology, biology, physics* 2010;76:287–95.

7. Spierer MM, Hong LX, Wagman RT, Katz MS, Spierer RL, McCormick B. Postmastectomy CT-based electron beam radiotherapy: dosimetry, efficacy, and toxicity in 118 patients. *International journal of radiation oncology, biology, physics* 2004;60:1182–9.
8. Vargo JA, Beriwal S. RTOG Chest Wall Contouring Guidelines for Post-Mastectomy Radiation Therapy: Is It Evidence-Based? *International journal of radiation oncology, biology, physics* 2015;93:266–7.
9. A011202 AfCTiOP. A RANDOMIZED PHASE III TRIAL COMPARING AXILLARY LYMPH NODE DISSECTION TO AXILLARY RADIATION IN BREAST CANCER PATIENTS (cT1-3 N1) WHO HAVE POSITIVE SENTINEL LYMPH NODE DISEASE AFTER NEOADJUVANT CHEMOTHERAPY. Updated 2016.
10. RTOG. Pragmatic Phase III Randomized Trial of Proton vs. Photon Therapy for Patients with Non-Metastatic Breast Cancer Receiving Comprehensive Nodal Radiation: A Radiotherapy Comparative Effectiveness (RADCOMP) Consortium Trial 2016.
11. Jagsi R, Moran J, Marsh R, Masi K, Griffith KA, Pierce LJ. Evaluation of four techniques using intensity-modulated radiation therapy for comprehensive locoregional irradiation of breast cancer. *International journal of radiation oncology, biology, physics* 2010;78:1594–603.
12. Ohri N, Cordeiro PG, Keam J, et al. Quantifying the impact of immediate reconstruction in postmastectomy radiation: a large, dose-volume histogram-based analysis. *International journal of radiation oncology, biology, physics* 2012;84:e153–9.
13. Chung E, Corbett JR, Moran JM, et al. Is there a dose-response relationship for heart disease with low-dose radiation therapy? *International journal of radiation oncology, biology, physics* 2013;85:959–64.
14. Xu N, Ho MW, Li Z, Morris CG, Mendenhall NP. Can proton therapy improve the therapeutic ratio in breast cancer patients at risk for nodal disease? *American journal of clinical oncology* 2014;37:568–74. [PubMed: 23466577]
15. Fagundes M, Hug E, Pankuch M, Fang C. Proton Therapy for local-regionally advanced breast cancer maximizes cardiac sparing. *Int J Particle Therapy* 2015;1:827–44.
16. Cuaron JJ, Chon B, Tsai H, et al. Early toxicity in patients treated with postoperative proton therapy for locally advanced breast cancer. *International journal of radiation oncology, biology, physics* 2015;92:284–91.
17. Henzen D, Manser P, Frei D, et al. Forward treatment planning for modulated electron radiotherapy (MERT) employing Monte Carlo methods. *Med. Phys* 2014; 41(3).
18. Henzen D, Manser P, Frei D, et al. Forward treatment planning for modulated electron radiotherapy (MERT) employing Monte Carlo methods. *Med. Phys* 2014; 41(12).
19. Renaud MA, Serban M, Seuntjens J. On mixed electron-photon radiation therapy optimization using the column generation approach. *Med. Phys* 2017; 44 (8): 4287–4298. [PubMed: 28500783]
20. Mueller S, Fix MK, Joosten A, et al. Simultaneous optimization of photons and electrons for mixed beam radiotherapy. *Phys. Med. Bio* 2017; 62: 5840–5860. [PubMed: 28467321]

Figure 1:

Illustration of chest wall 6/9MeV combined beam arrangement with photon Scav field. Contours IMN in blue and CTV_CW in green. (a) axial slice 4.2 cm superior of CAX; (b) CAX slice; (c) axial slice 4.2 cm inferior of CAX; (d) Illustration of beam arrangement on the surface of the patient: 6X photon Scav field, matched on the skin with electron chest wall fields. All electron fields have the same isocenter at 105cm SSD but with different cutouts for different energies; (e) Junction between photon and electron fields 1cm, junction between electron fields 0.5cm.

Figure 2:

Illustration of chest wall 6/9/12MeV combined beam arrangement with photon Scav field. Contours IMN in blue and CTV_CW in green and Axilla Node in yellow. (a) axial slice 5 cm superior of CAX; (b) CAX slice; (c) axial slice 3 cm inferior of CAX; (d) Illustration of beam arrangement on the surface of the patient: 6X photon Scav field, matched on the skin with electron chest wall fields. All electron fields have the same isocenter at 105cm SSD but with different cutouts for different energies; (e) Junction between photon and electron fields 1cm, junction between electron fields 0.5cm.

Figure 3:
Composite dose distribution and DVH for the patient illustrated in Figure 2. For this patient, the mean heart dose was 4.29Gy, V20Gy of left lung was 34.1%.

Table 1:

Clinical Planning Criteria for electron CW planning technique (Prescription dose 5000cGy) at our institution.

Electron Chest wall Technique: Electron Chest wall + SCV/PAB (Day1 and Day2)				
For dose distribution evaluation: Global Maximum Dose is typically in the SCV area. 4750cGy (95%) isodose line should connect in the CW/SCV junction. 4750cGy (95%) should not break up in chest wall region. 5000cGy (100%) should only cover to the anterior of the ribs. At least 5mm bolus in chest wall fields for skin dose coverage (4750cGy (95%) should cover the skin)				
Plan to Evaluate			Ideal	Acceptable
SCV/PAB Plan Only	3D Point Dose Max		125%	130%
CW Plan Only	3D Point Dose Max		125%	130%
	3D Point Dose Max		70Gy (140%)	75Gy (150%)
Total Composite (Breast/CW + IMN + SCV/PAB)	Body		V6500cGy (130%) 10cc	V6750cGy (135%) 10cc
	CTV_CW	D95%	4750cGy (95%)	
		D90%		4500cGy (90%)
	Body	V5400cGy (108%)	25%	50%
	TumorBed	D95%	5000cGy (100%)	4750cGy (95%)
	IMN	D95%	4500cGy (90%)	
		D90%		4000cGy (80%)
	Nodal PTV	D95%	4750cGy (95%)	
		D90%		4500cGy (90%)
	Ipsilateral Lung	V50Gy	2%	4%
		V20Gy	35%	38%
		V10Gy	50%	60%
		V5Gy	65%	70%
	Heart (Left Sided Cases)		V20Gy 5%	V30Gy 5%
		Mean Dose	4Gy	7Gy
	Heart (Right Sided Cases)		V20Gy 2%	V30Gy 2%
		Mean Dose	4Gy	6Gy

Table 2.

Dosimetry Data from the Day1-Day2 composite plan for 10 left sided chest wall patients.

		Mean $\pm$ SD	Range
CTV_CW	D95% (Gy)	44.5 $\pm$ 2.6	(41.7—49.8)
	D90% (Gy)	47.8 $\pm$ 1.8	(45.4 – 50.7)
	V90% (%)	93.0 $\pm$ 2.3	(90.5 – 96.9)
	D05 (Gy)	57.6 $\pm$ 0.9	(56.4 – 59.1)
Heart	Dmax (Gy)	38.8 $\pm$ 8.7	(23.9 –49.6)
	V30Gy (%)	0.5 $\pm$ 0.6	(0—1.6)
	V25Gy (%)	1.2 $\pm$ 1.1	(0—3.1)
	V20Gy (%)	2.4 $\pm$ 1.7	(0.3 –5.2)
	Dmean (Gy)	3.0 $\pm$ 0.8	(1.6 – 4.3)
Lung_L	V50Gy (%)	0.8 $\pm$ 0.7	(0 – 2.5)
	V20Gy (%)	33.2 $\pm$ 4.5	(24.4 – 38.8)
	V10Gy (%)	51.6 $\pm$ 7.6	(38.7 – 65.0)
	V5Gy (%)	64.6 $\pm$ 9.6	(49.9 – 84.2)
Lung_R	V20Gy (%)	0.6 $\pm$ 0.8	(0 –2.6)
	V5Gy (%)	5.1 $\pm$ 5.0	(0 – 16.6)
IMN	D95% (Gy)	40.9 $\pm$ 1.5	(39.0 – 43.1)
	D90% (Gy)	43.0 $\pm$ 1.2	(40.7 – 44.8)
Breast-Contralateral	V3Gy (%)	4.6 $\pm$ 3.6	(0.4 – 12.6)
	V4Gy (%)	3.9 $\pm$ 3.4	(0.3—11.5)
	V5Gy (%)	3.3 $\pm$ 3.1	(0.1 – 10.6)
	Mean Dose (Gy)	0.9 $\pm$ 0.7	(0.2 – 2.6)
Body	V54Gy (%)	38.2 $\pm$ 7.6	(28.1 – 49.9)
	V65Gy(cc)	15.4 $\pm$ 8.8	(4.3 – 30.1)
	V67.5Gy (cc)	6.0 $\pm$ 4.6	(0.4 – 14.5)
	Dmax (Gy)	72.7 $\pm$ 1.9	(69.5 – 75.0)