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Surface Guided Planning and Dose Visualization with Whole Breast Treatments

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AdventHealth Celebration

Disclosures

- AH Celebration has a COE agreement with VisionRT

Outline

- Surface Guided Planning
  - Clearance Mapping
  - Plan Optimization
- Surface Guided Dose Visualization
  - Cherenkov Imaging
  - Real Time Dose Visualization
- Clinical Examples
  - DIBH Breast
  - Prone Breast
- Conclusions

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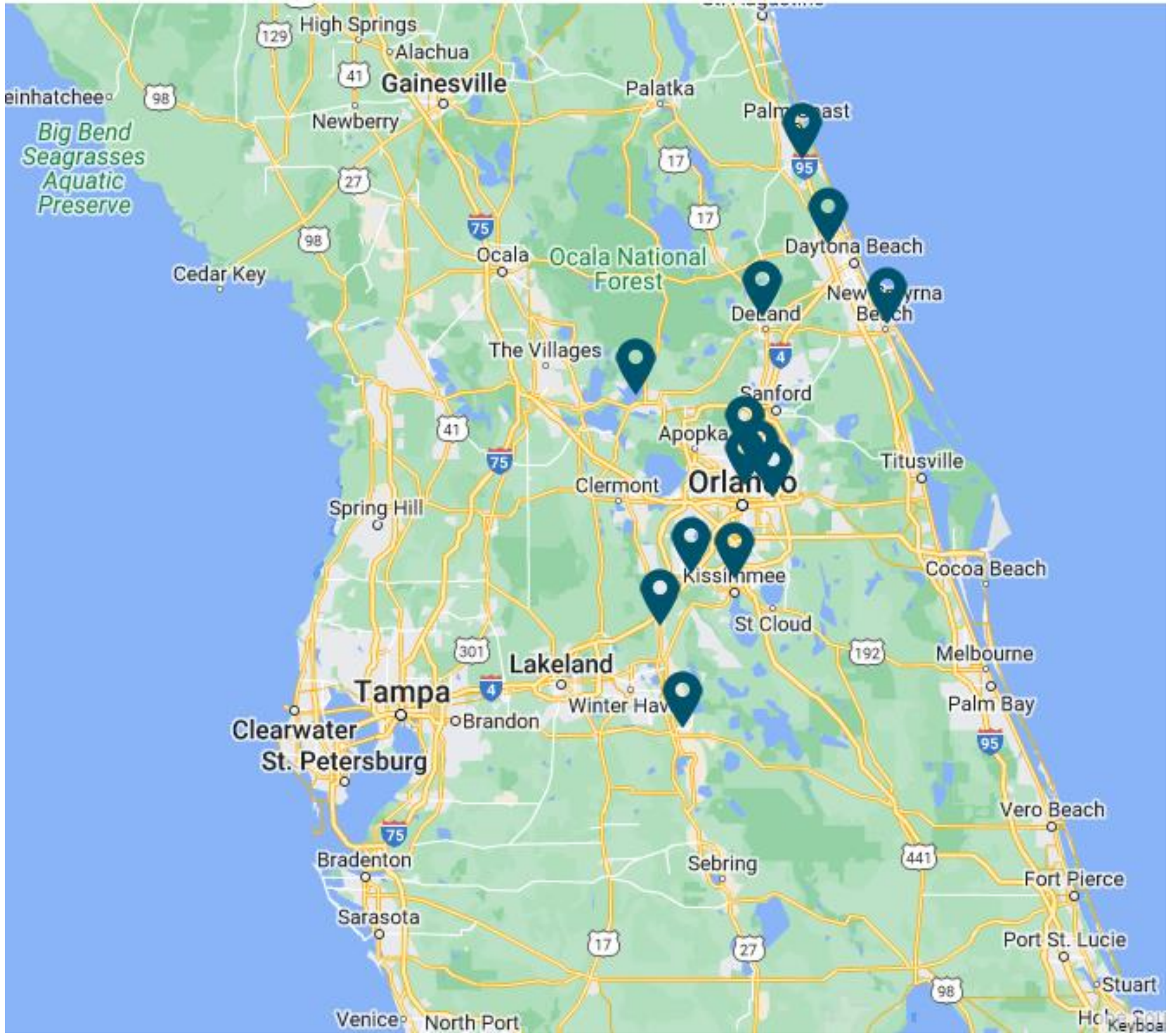

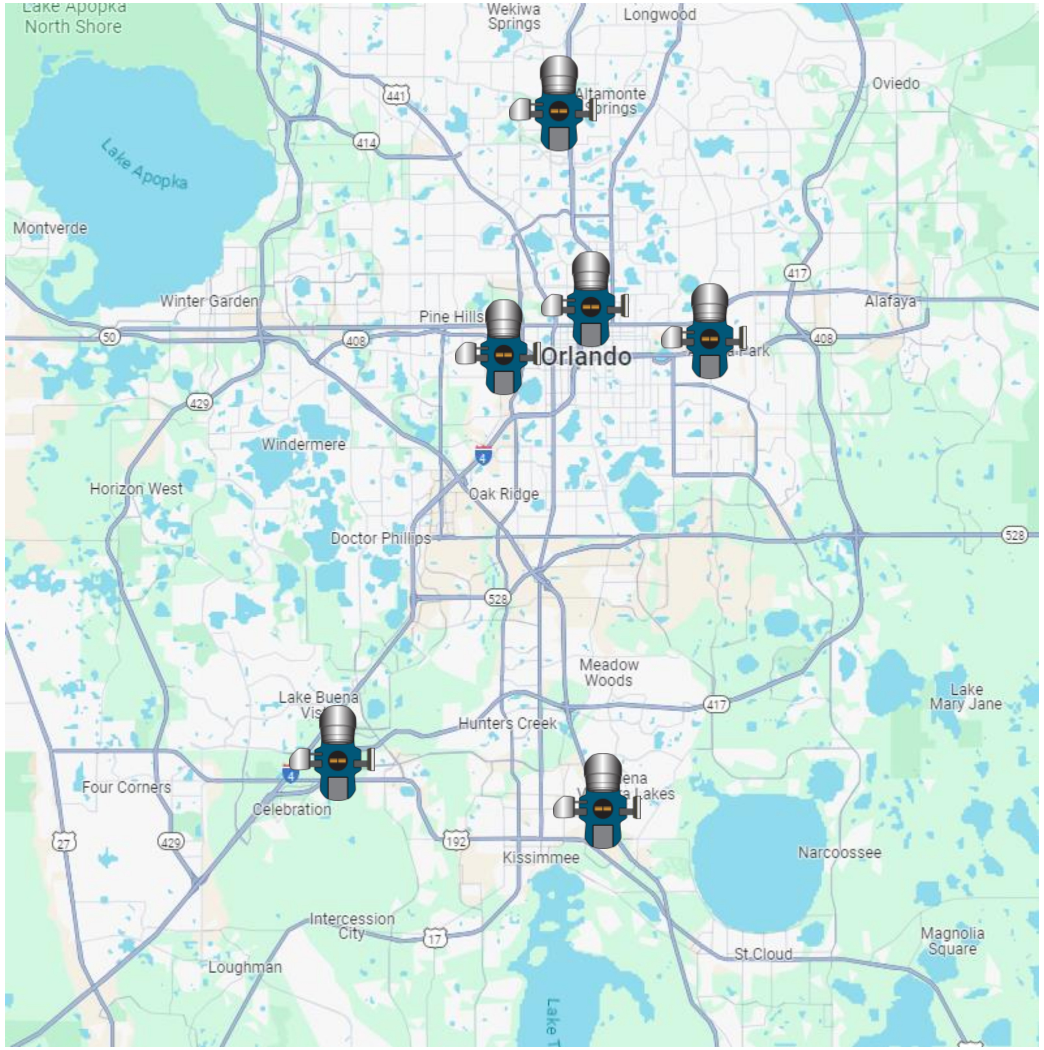

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- 2 Varian Truebeam
- Siemens SOMATOM Confidence CT
- 2 AlignRT systems
- SimRT
- MapRT
- DoseRT
- PatientID

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The Goals of a Treatment Plan

- Deliver a high dose of radiation to the target while minimizing the dose to normal tissue and organs at risk.
- Each plan is customized for each patient since share and location of the target will vary from patient to patient.
- Some plans will require complex planning techniques such as non-coplanar treatments.

Non-Coplanar Planning Advantages

- Improved dose conformity
  - Reduces treatment hotspots
- Critical structure sparing
  - Reduces OAR dose that are close to the target
- Flexibility in complex anatomy
  - Targets with irregular shape or location can still be treated precisely.
- Better clinical outcome for the patient

Non-Coplanar Treatments - Examples

RADIATION ONCOLOGY PHYSICS

WILEY

Dosimetric comparison of coplanar and noncoplanar beam arrangements for radiotherapy of patients with lung cancer: A meta-analysis

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Abstract

Purpose: Radiotherapy plays an important role in the treatment of lung cancer, and both coplanar beam arrangements (CBA) and noncoplanar beam arrangements
(NCB the ques-
tion v
Meth ience, and
the C ing: ((non-
copla or ("lung
tumo py")). The
incluc nd funnel
plots symmetry
tests
Resul and treat-
ment arget vol-
umes x (GI) had
no st the whole
lung in NCBA
plans lung, the
maxir hibited no
signif npared.
Concl significant
advantages in reducing V20 of the whole lung and max dose of spinal cord.

KEY WORDS
coplanar beam arrangement, lung cancer, meta-analysis, noncoplanar

Dosimetric Comparision of Coplanar versus Noncoplanar Volumetric Modulated Arc Therapy for Treatment of Bilateral Breast Cancers

Avinav Bharati, Satyajeet Rath[1], Rohini Khurana[2], Madhup Rastogi[2], Susama R. Mandal[3], Ajeet Kumar Gandhi[2], Rahat Hadi[2], Anoop K. Srivastava[2], Surendra Prasad Mishra[2]

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Abstract

Introduction: The purpose of this stud lated arc therapy (VMAT) treatment
plans using coplanar and noncoplanar be rgan at risk sparing and target volume
coverage. The hypothesis was to test wh livery to critical organs such as heart
and lung, which will result in lesser ove reated at our hospital were retrieved.
Computed tomography simulation data the parameters were compared with
standard VMAT coplanar plans. Contou . Forty-five Gray in 25 fractions was
planned followed by 10 Gy in five fractio ence in planning target volume (PTV)
coverage was found for the right breast/ total PTV ($P = 0.929$). Noncoplanar
beams resulted in better cardiac sparing .80 ± 0.28 − 7.28 ± 0.33, $P < 0.001$).
The D_{mean}, V_{20} and V_{30} values for total l atistically significant difference. The
average monitor units (MUs) were simi MU), but the overall treatment time
was higher in noncoplanar plans due t VMAT plans, the mean conformity
index was slightly better although the l ith noncoplanar beam arrangements
had significant dosimetric advantages in ith almost equivalent lung doses and
equally good target coverage. Larger st this data.

Keywords: Bilateral breast cancer, non rc therapy

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Noncoplanar VMAT for nasopharyngeal tumors: Plan quality versus treatment time

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Purpose: The authors investigated the potential of optimized noncoplanar irradiation trajectories for volumetric modulated arc therapy (VMAT) treatments of nasopharyngeal patients and studied the trade-off between treatment plan quality and delivery time in radiation therapy.
Methods: For three nas s for nine different
delivery scenarios using enarios according
to dose characteristics, . In particular, the
authors generated the f equenced, fluence
optimized plan that uses ections and marks
a theoretical upper limit 72 coplanar beam
directions as pendant to coplanar step and
shoot (SnS) plan, (5) a (6) a noncoplanar
BAO SnS plan, (7) a V VMAT plan with
an optimized great circl n with an arbitrary
trajectory around the pa
Results: VMAT using o ean and maximum
doses in organs at risk e while the target
coverage remains cons r SnS or VMAT;
however, noncoplanar p AT yielded a better
plan quality than the be plans depended on
the length of the traject stimated to be 6.5
min in average; 1.6 min han a noncoplanar
SnS plan with compara
Conclusions: The authors' study reconfirms the dosimetric benefits of noncoplanar irradiation of nasopharyngeal tumors. Both SnS using optimized noncoplanar beam ensembles and VMAT using an optimized, arbitrary, noncoplanar trajectory enabled dose reductions in organs at risk compared to coplanar SnS and VMAT. Using great circles or simple couch rotations to implement noncoplanar VMAT, however, was not sufficient to yield meaningful improvements in treatment plan quality. The authors estimate that noncoplanar VMAT using arbitrary optimized irradiation trajectories comes at an increased delivery time compared to coplanar VMAT yet at a decreased delivery time compared to noncoplanar SnS IMRT.

Non-Coplanar Planning Concerns

- Longer treatment time
  - Manual couch motion
  - Patient motion
- Collision Risk
  - Requires a dry run
- Complex patient positioning
  - Complex setup

MapRT!

MapRT Cameras

SimRT Camera

Surface Guided Planning - Workflow

- In the CT sim room
  - Capture surface prior to CT sim
  - Check for collisions
  - Adjust patient position or immobilization device accordingly.
- Treatment Planning
  - Use clearance map to optimize the plan
- Treatment
  - Plan can be safely delivered

Surface Guided Planning – Lt APBI

- 75-year-old female with malignant neoplasm of the central portion of the left breast
- VMAT DIBH plan, 267cGy x 15 fractions

Planning Options – Coplanar or Non-Coplanar

- 2 Field VMAT DIBH
  - CCW G155-G330
  - CW G330-G155
  - 578 MUs

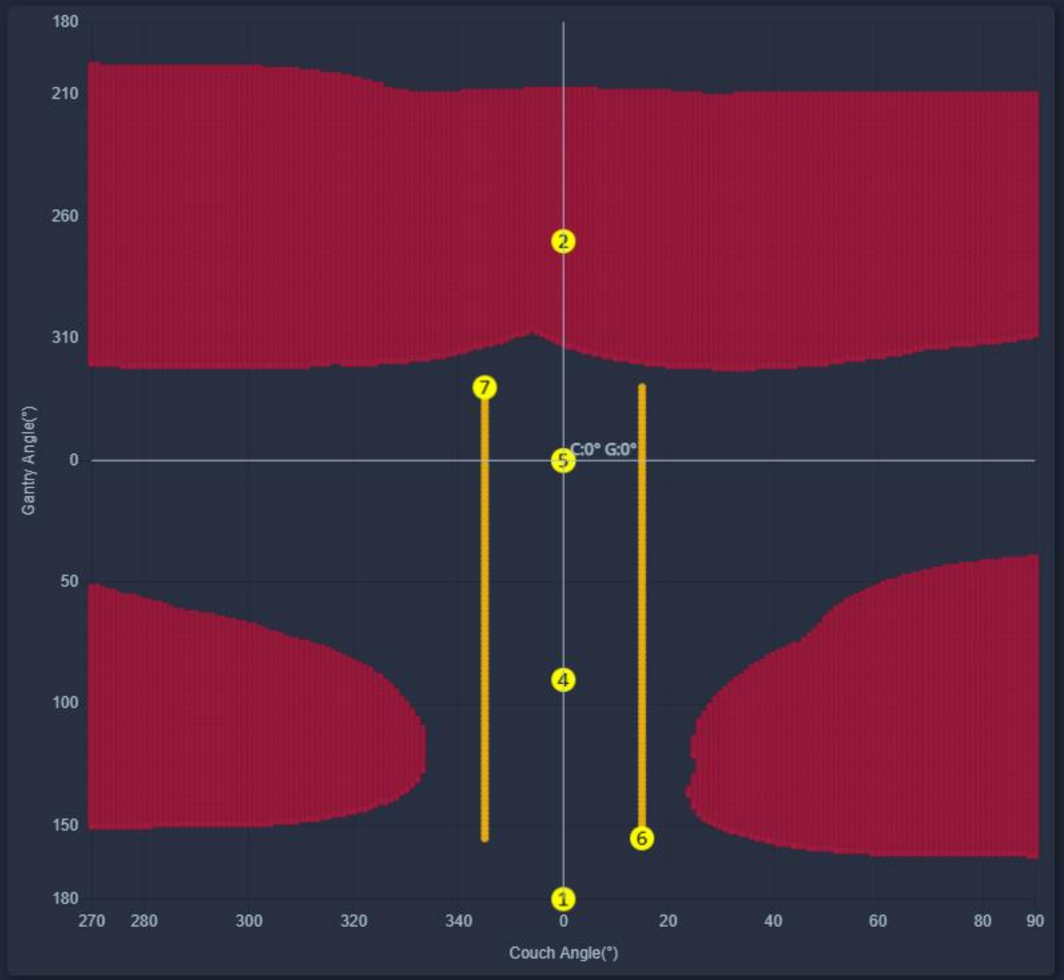
- 2 Field VMAT DIBH with Non-Coplanar Fields
  - CCW G155-G330, T345
  - CW G330-G155, T15
  - 482 MUs

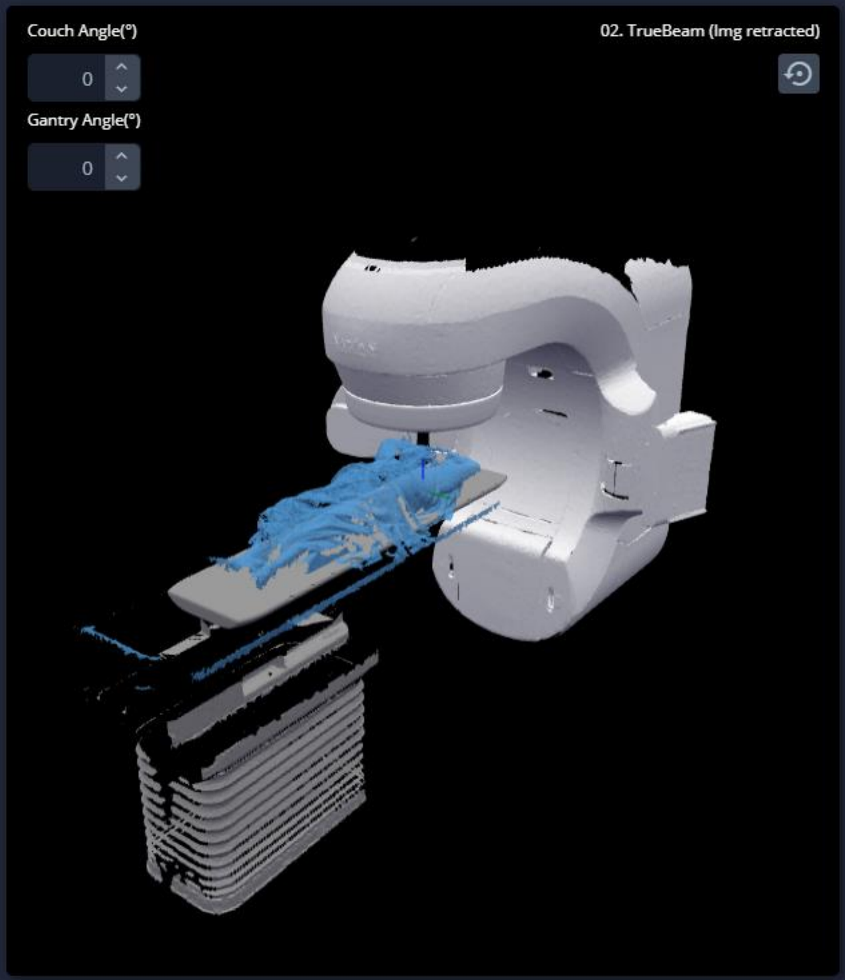
Structure	Constraint	Lt APBI CP	Lt APBI NCP	Difference
Lumpectomy_Lt	95% ≥ 95%	99.981%	99.952%	0.029
Lumpectomy_Lt	V100% ≤ 93%	95%	95%	0
Lumpectomy_Lt	Max ≤ 107%	105.619%	104.427%	1.192
Heart	V1600cGy ≤ 5%	0%	0%	0
Heart	Mean ≤ 200cGy	112cGy	110cGy	2
Lung_L	V1750cGy ≤ 15%	0%	0%	0
Lung_L	V880cGy ≤ 10%	0%	0%	0
Lung_L	V144cGy ≤ 5%	11.972%	2.66%	9.312
Breast_R	V144cGy ≤ 10%	0%	0%	0
Lung_R	V440cGy ≤ 10%	0%	0%	0

Clearance Map – Lt APBI

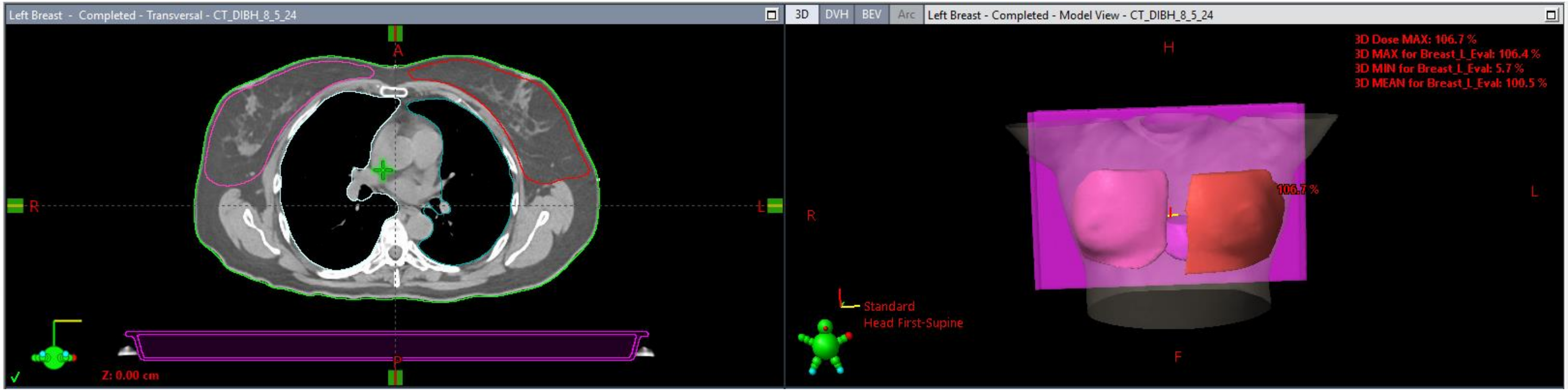
LPartia_ER

Status	#	ID	Type	Gantry	Couch	Direction	☑
✔	1	R1 PA ISO	Static	180°	0°	--	☑
✖	2	R2 RLAT ISO	Static	270°	0°	--	☑
✔	3	AP ISO	Static	0°	0°	--	☑
✔	4	LLAT ISO	Static	90°	0°	--	☑
✔	5	CBCT AP ISO	Static	0°	0°	--	☑
✔	6	RA1 CCW	Arc	155° to 330°	15°	CC	☑
✔	7	RA2 CW	Arc	330° to 155°	345°	CW	☑





Planning with a Clearance Map - Lt Breast



- 65-year-old female with intraductal carcinoma of the left breast
- 3D conformal plan, 267cGy x 15 with a 1000cGy boost

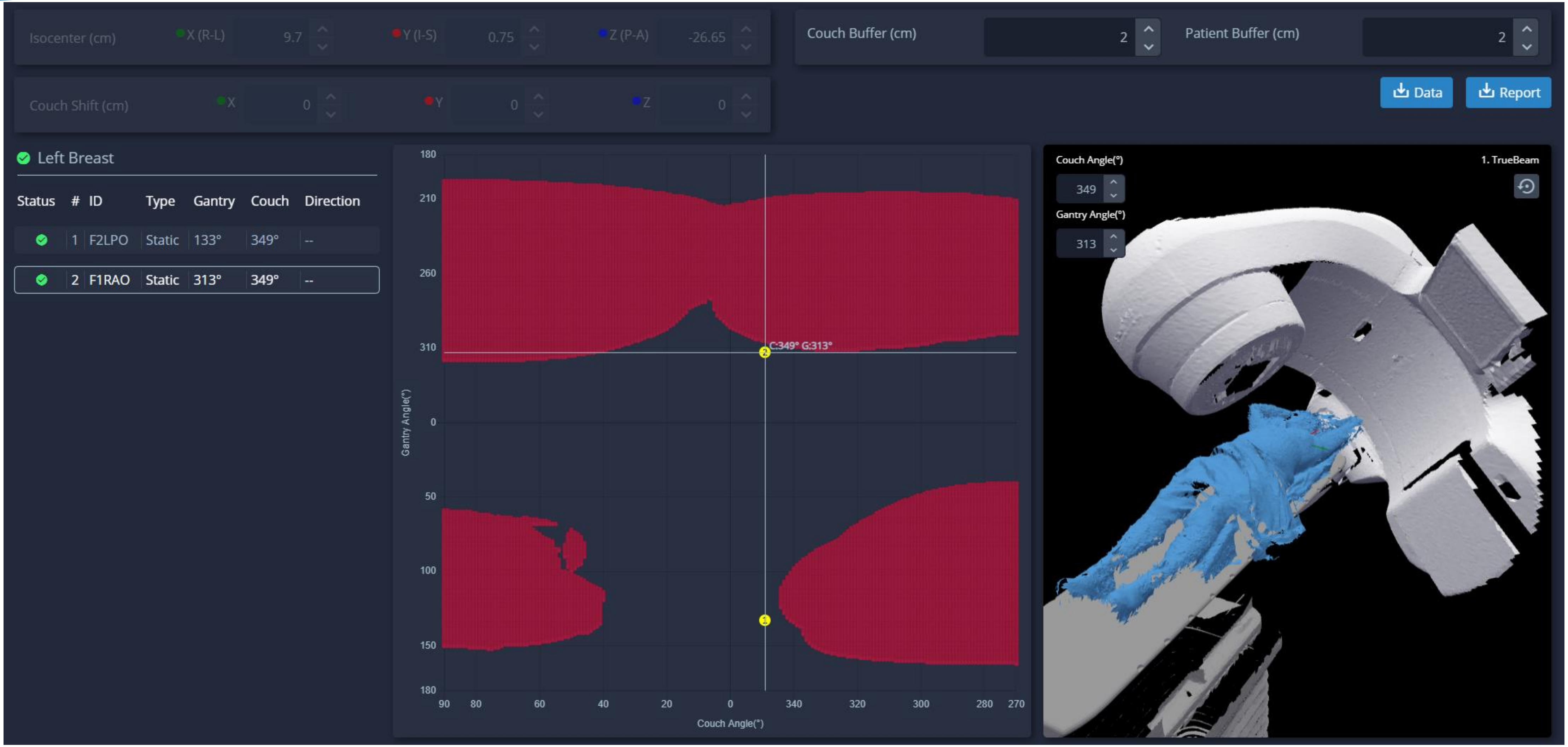
Surface Guided Planning – 3D Tangents

- 2 Field 3D Conformal plan
  - RAO G313
  - LPO G133

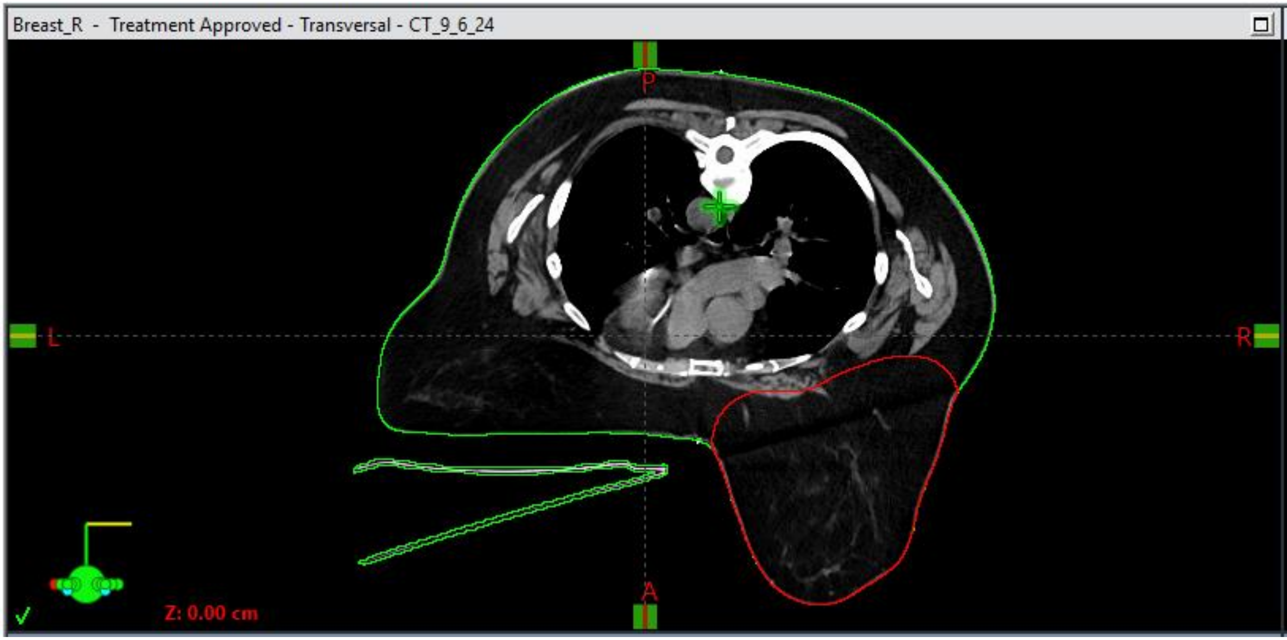
- 2 Field 3D Conformal non-coplanar plan
  - RAO G313, T349
  - LPO G113, T349

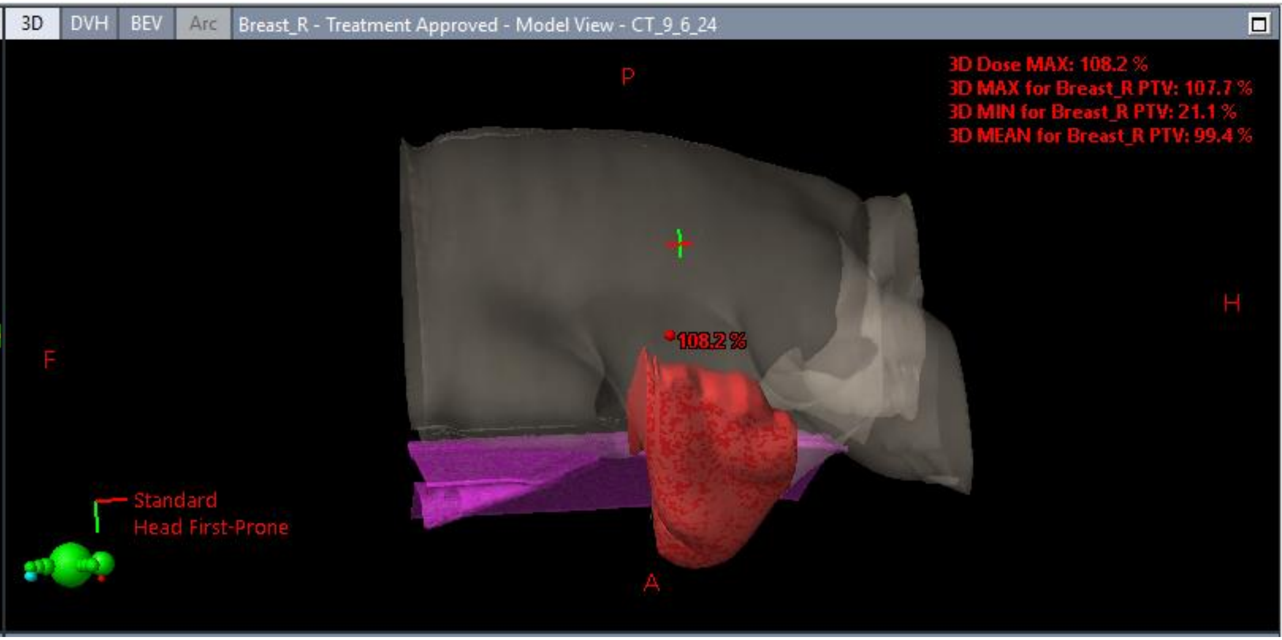
Structure	Constraint	Left Breast CP	Left Breast NC	Difference
Lt Breast/CW	95% ≥ 95%	96%	95.894%	0.106%
Lt Breast/CW	V107% ≤ 10cc	29.28cc	0cc	29.28cc
Lt Breast/CW	Max ≤ 110%	109.54%	106.41%	3.13%
Lt Breast/CW	D10% ≤ 105%	106.372%	103.836%	2.536%
Heart	V1800cGy ≤ 10%	0.02%	0.017%	0%
Heart	Mean ≤ 160cGy	148.8cGy	127.4cGy	21.4
Lung_L	V1440cGy ≤ 10%	14.374%	14.389%	-0.015%
Breast_R	V240cGy ≤ 10%	0%	0%	0%
Lung_R	V384cGy ≤ 5%	0%	0%	0.%

Clearance Check!



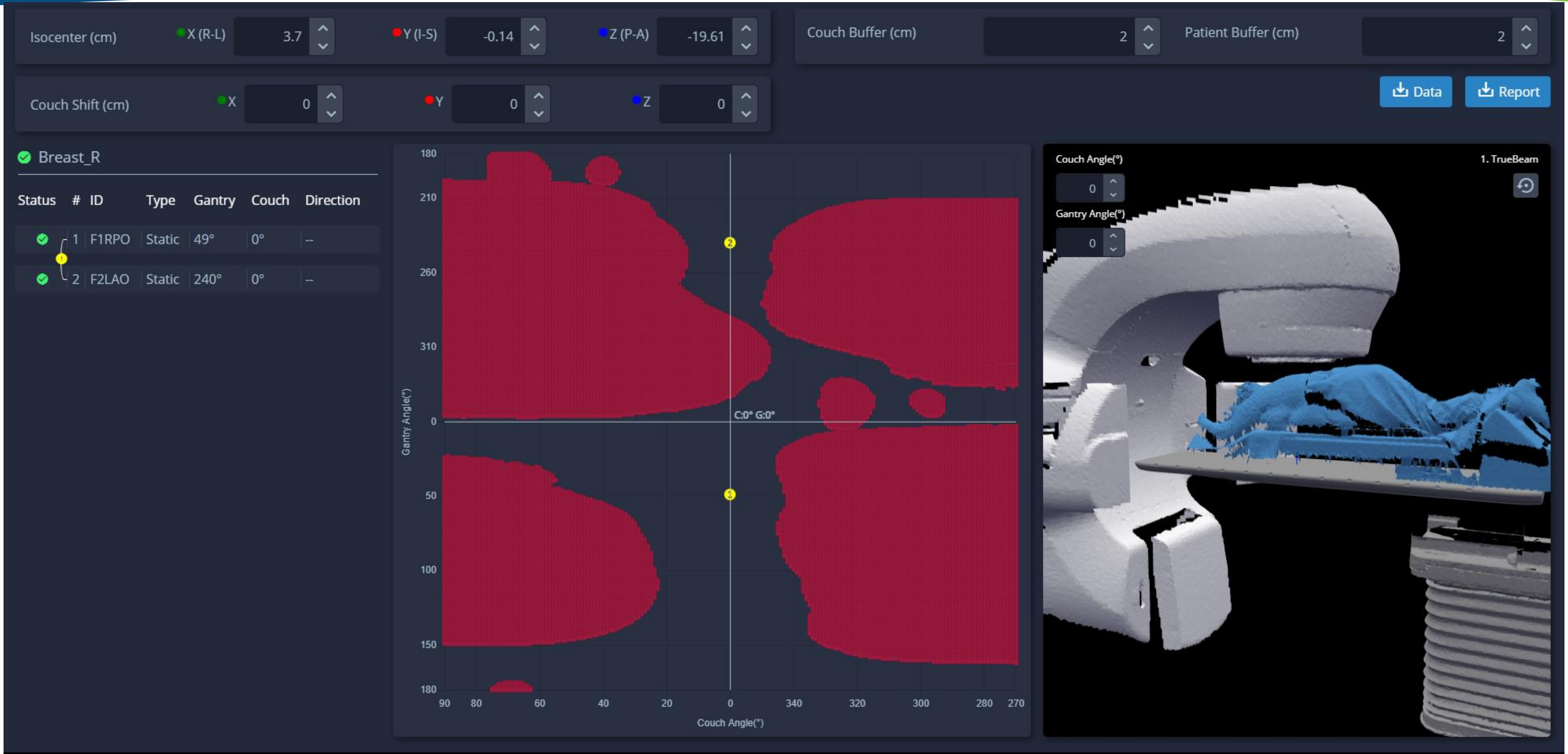
Surface Guided Planning – Prone Breast





- 64-year-old female with right breast intraductal carcinoma
- Prone plan, 267cGy x 15 plus a boost of 200cGy x8

Clearance Map – Left Breast



Learn More About Surface Guided Planning!

SGRT COMMUNITY

SGRT in Planning: Our Clinical Experience in Surface Guided Clearance Mapping

Siqiu Wang, PhD
Medical Physics Resident
University of Texas Southwestern

View video

Use of MapRT to optimise noncoplanar planning for head and neck patients

Helen Convery
Senior Dosimetrist (Development and Clinical Trials)
Raigmore Hospital Inverness, UK

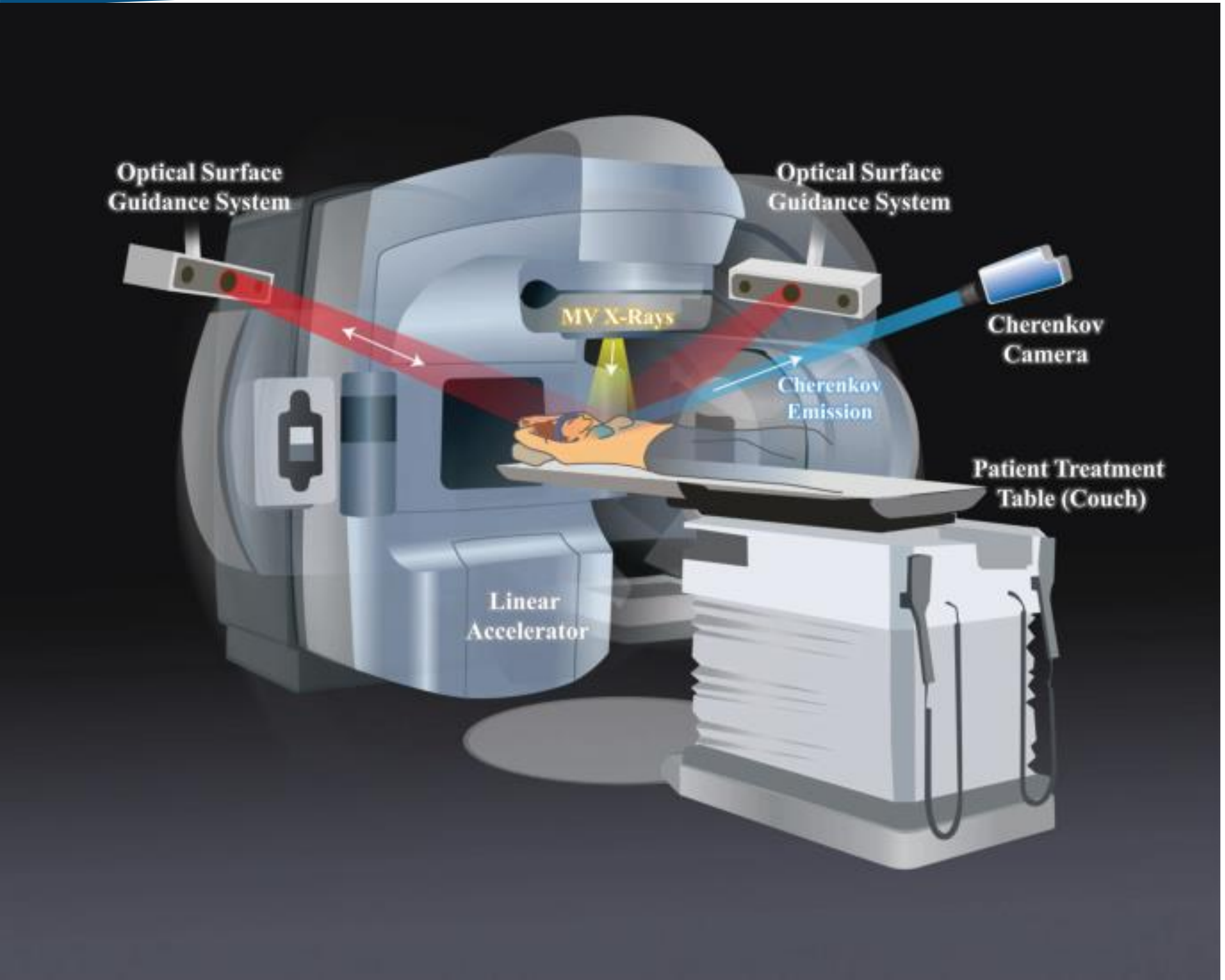
View video

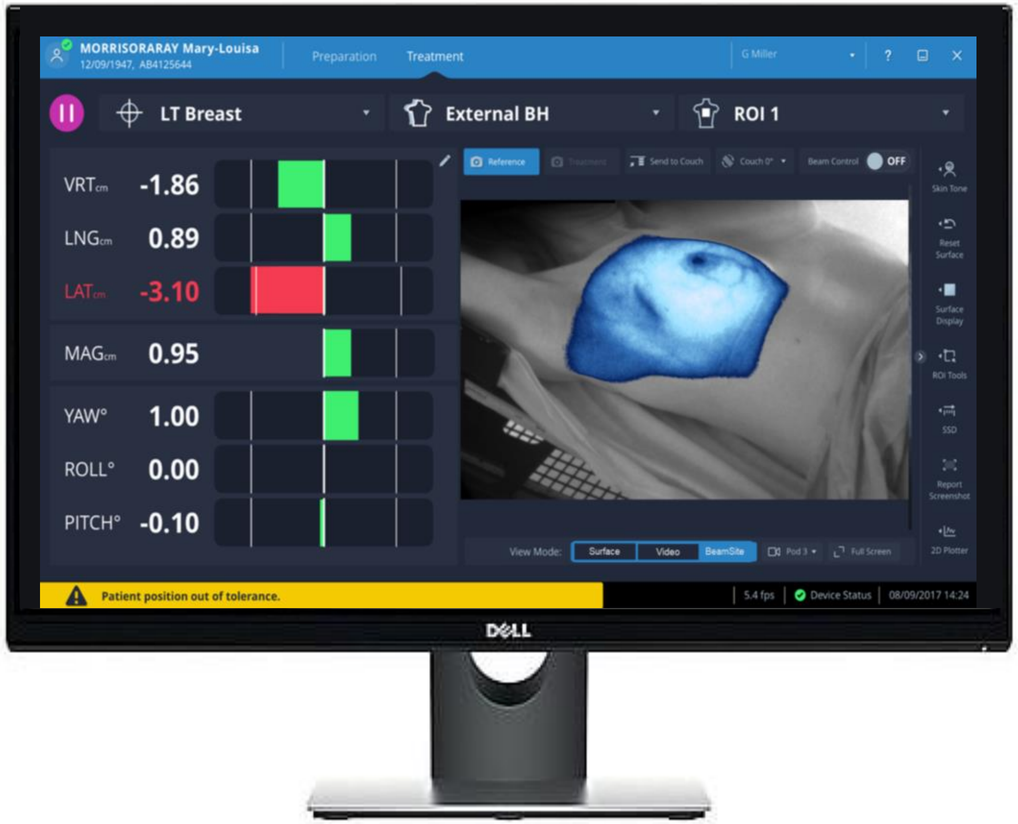
Improving efficiencies with MapRT

David Parsons, PhD
Associate Director of Medical Physics Residency Program, University of Texas Southwestern, Dallas, Texas, USA

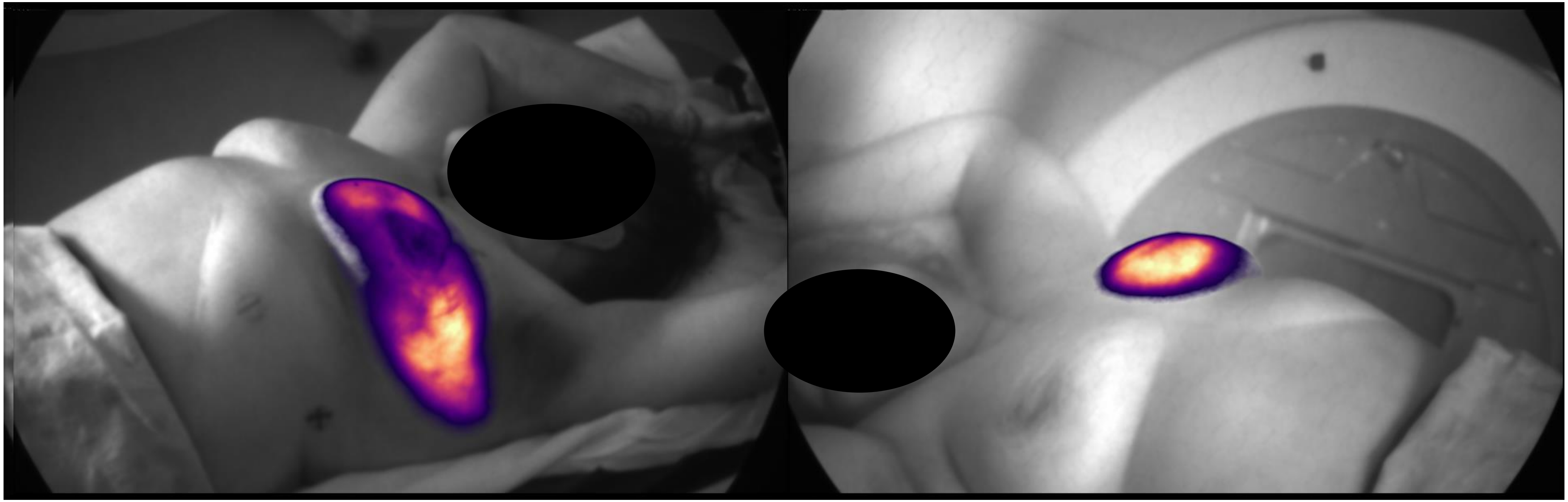
View video

Cherenkov Imaging



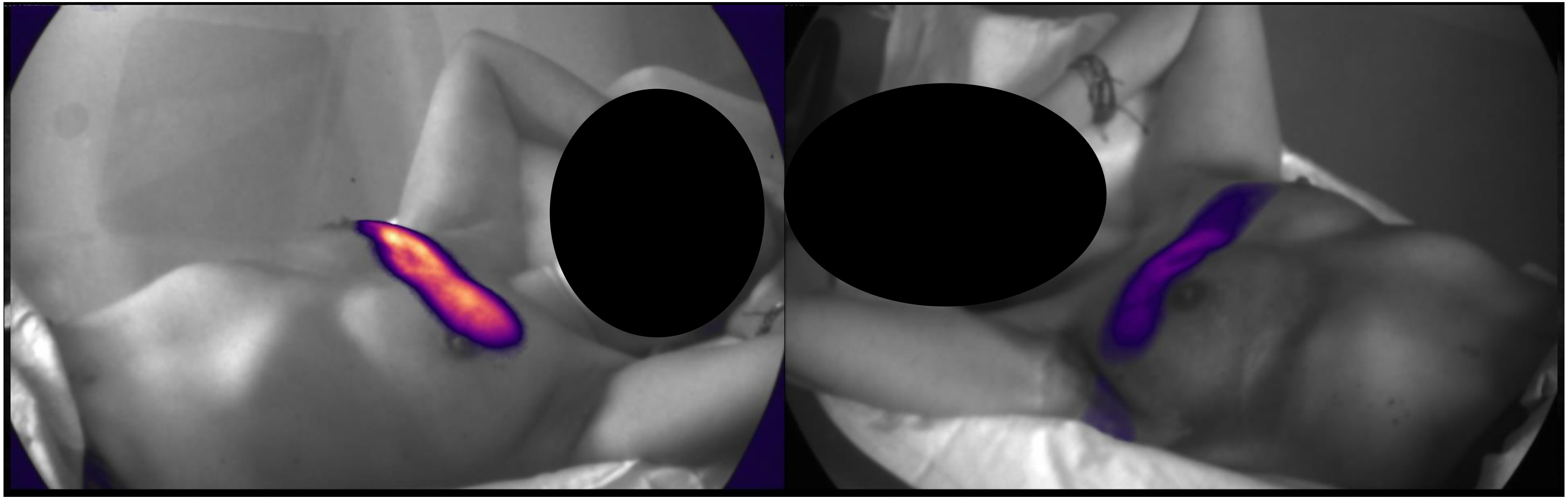


Left Breast (Our First Case)



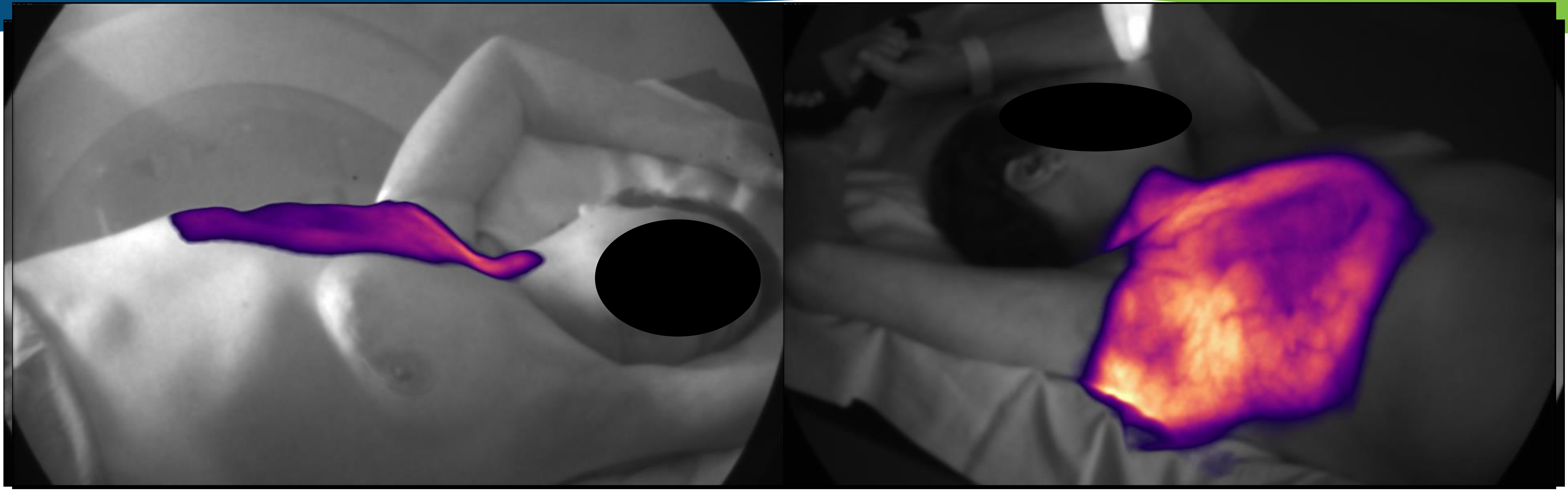
- 71-year-old female, whole left breast treatment.
- Patient mentioned irritation in her left armpit after her treatment.
- DoseRT was used on her last fraction before her boost.

Breast Boost (Our Second Case)



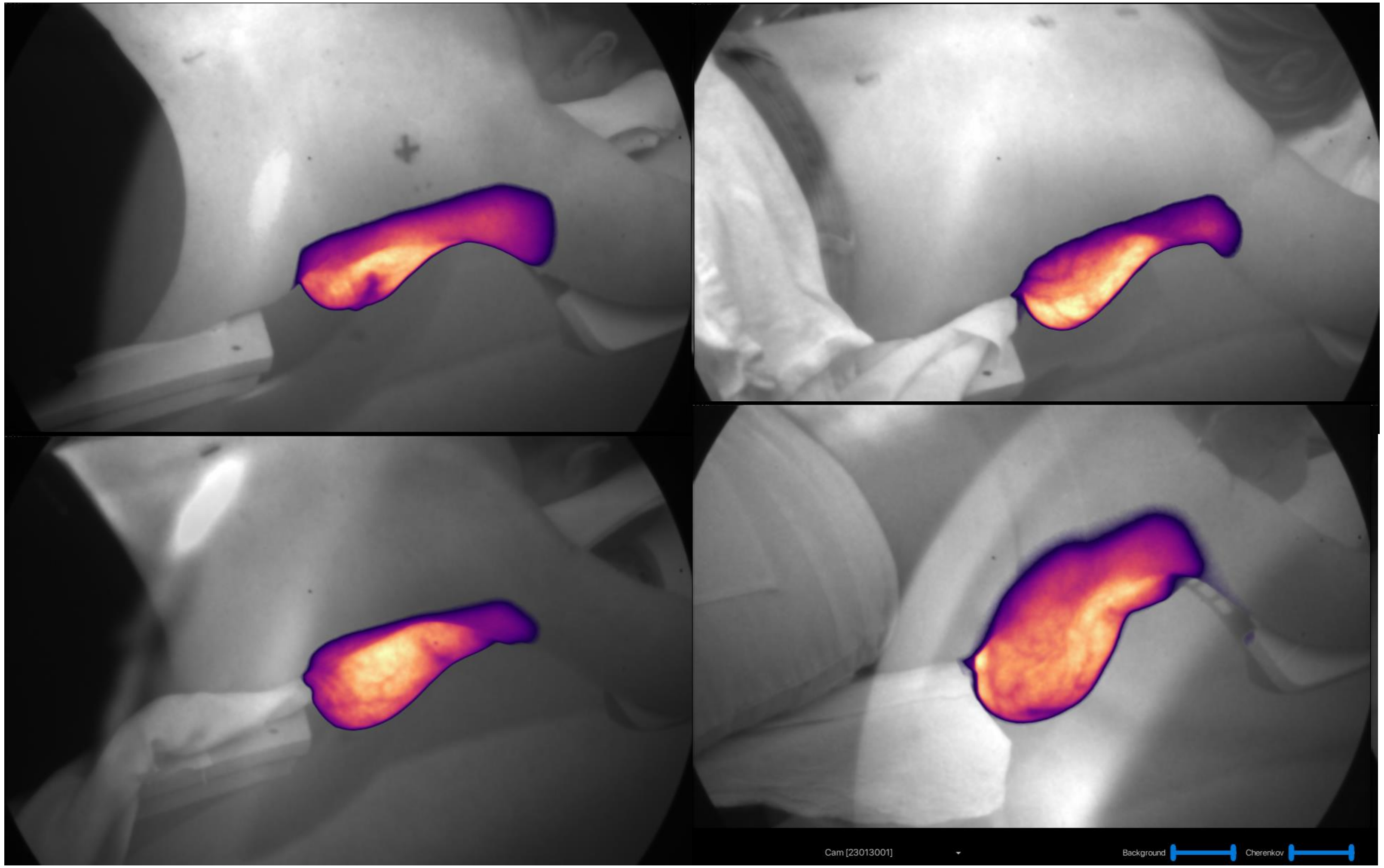
- 55-year-old female, right breast boost treatment.
- Therapists noticed dose in the contralateral breast.
- DoseRT was used on fraction 4/5.

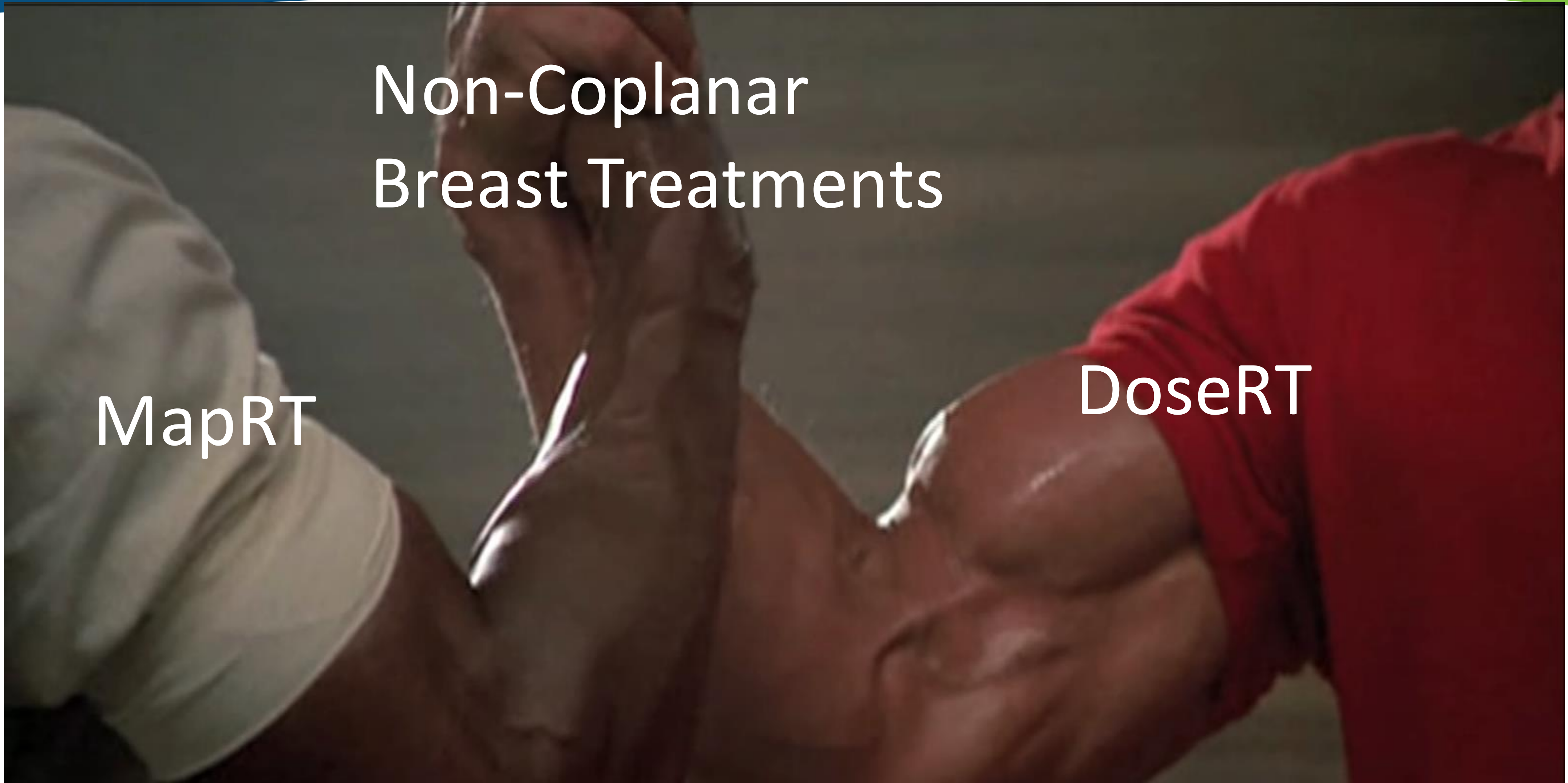
Breast with Bolus



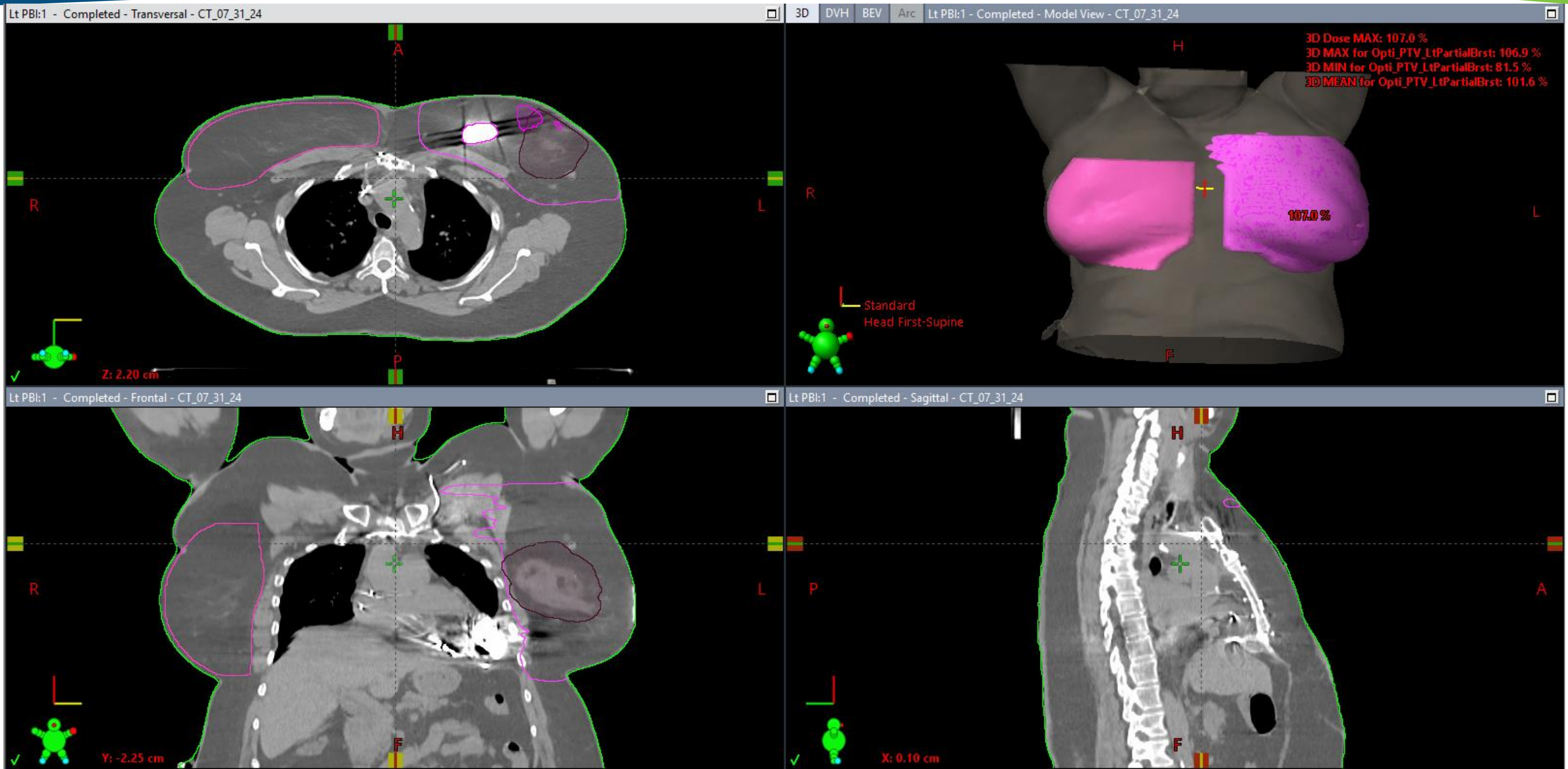
- 62-year-old female, whole right breast treatment. Bolus/no bolus treatment
- On fraction 8 her bolus was misplaced
- Corrected right away and closely monitored after.

Prone Breast Examples




Non-Coplanar
Breast Treatments
MapRT
DoseRT

Non-Coplanar Left Breast Treatment

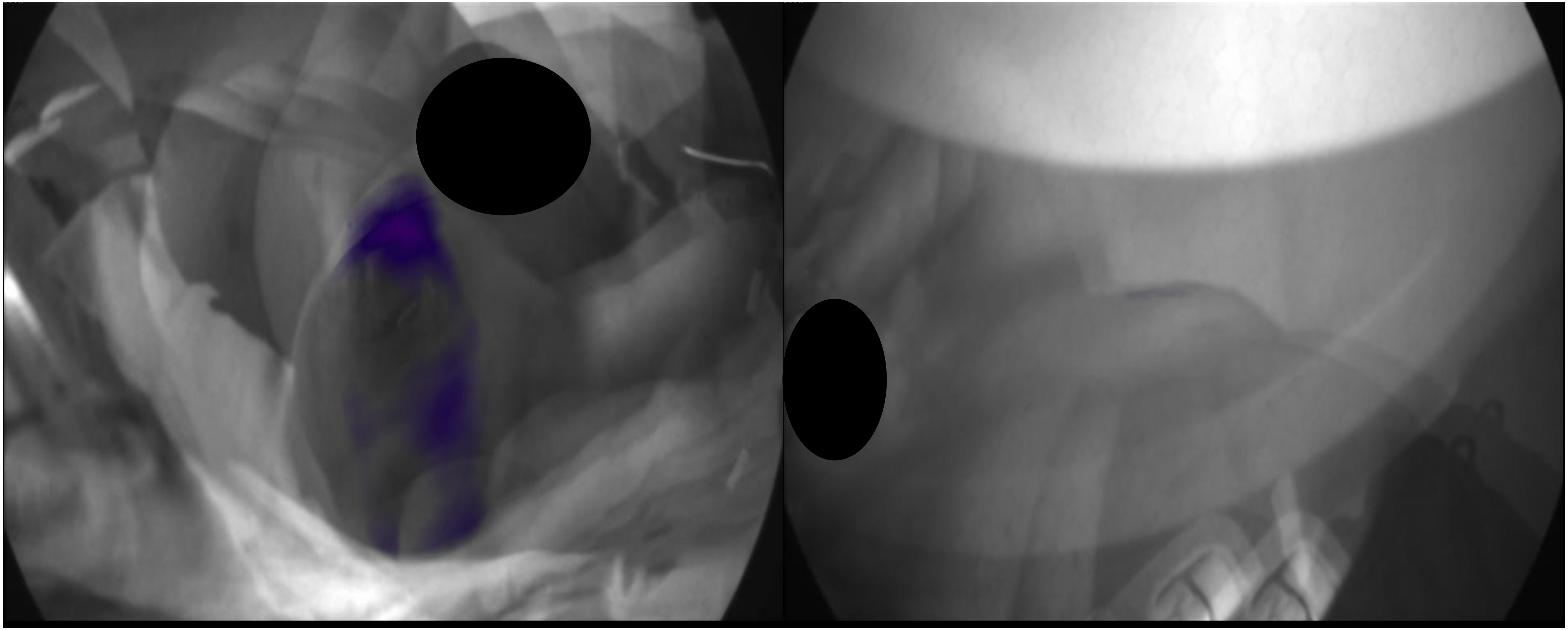


Surface Guided Planning

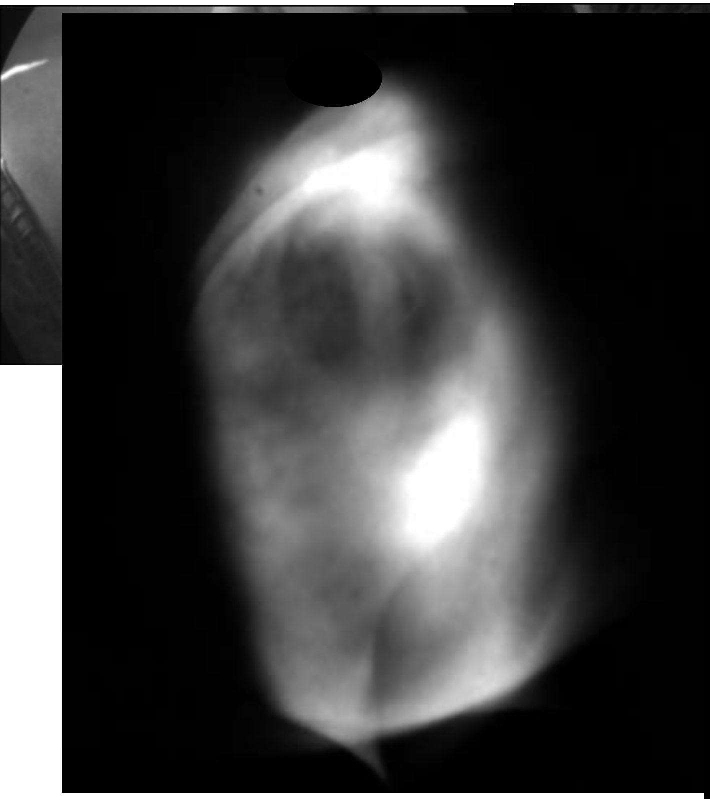
- 5 Field Static IMRT non-coplanar plan
  - G179.9, T0
  - G325, T90
  - G330, T50
  - G350, T10
  - G350, T0
- 3D tangent plan (FiF)
  - RAO G350
  - LAO G178

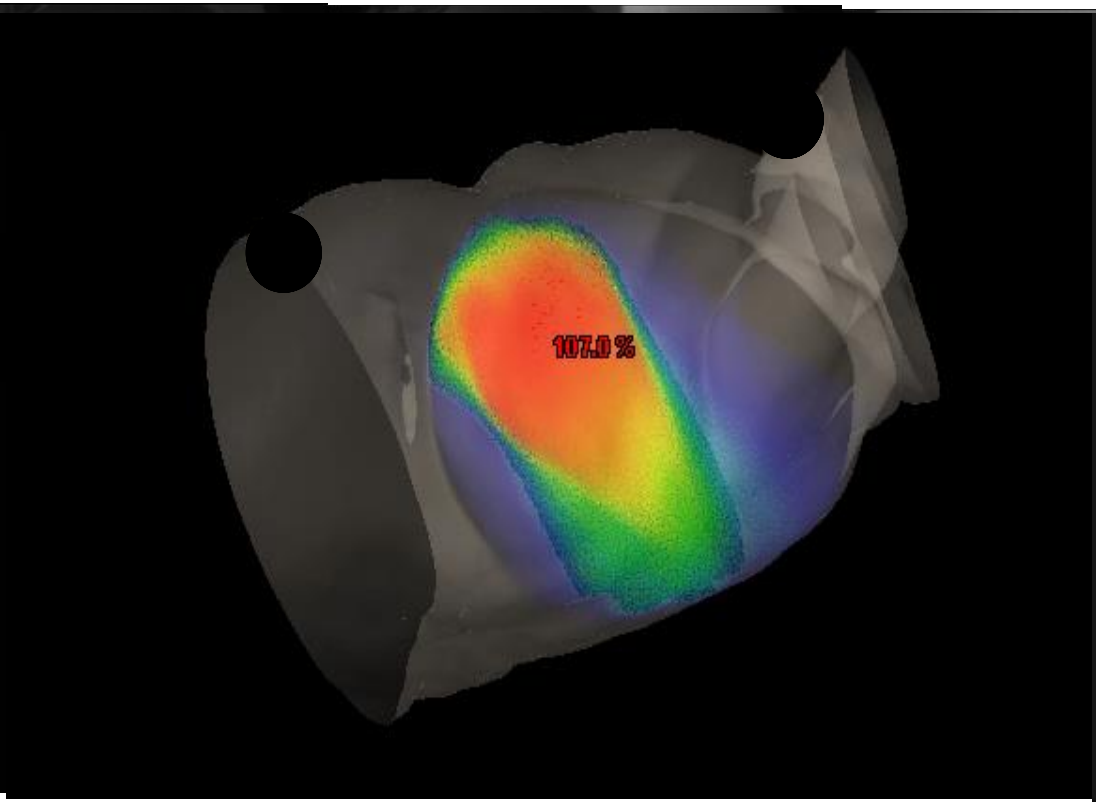
Structure	Constraint	Left Breast PBI (NCP)	Left Breast PBI (CP)
Lt Breast PTV	95% ≥ 95%	99.437%	57.833%
Lt Breast PTV	Max ≤107%	106.855cc	107.679%
Lt Breast PTV	V100%≥93%	75.667%	28.54%
Heart	V1600cGy ≤ 5%	0.00%	0%
Heart	Max ≤ 200cGy	157.2cGy	194.8cGy
Lung_L	V1750cGy ≤ 15%	0.022%	0.381%
Lung_L	V880cGy ≤ 35%	0.266%	1.02%
Breast_R	V144cGy ≤ 5%	0%	0%
Lung_R	V440cGy ≤ 10%	0%	0%
ICD	Max ≤ 100cGy	391.8cGy	667.3cGy

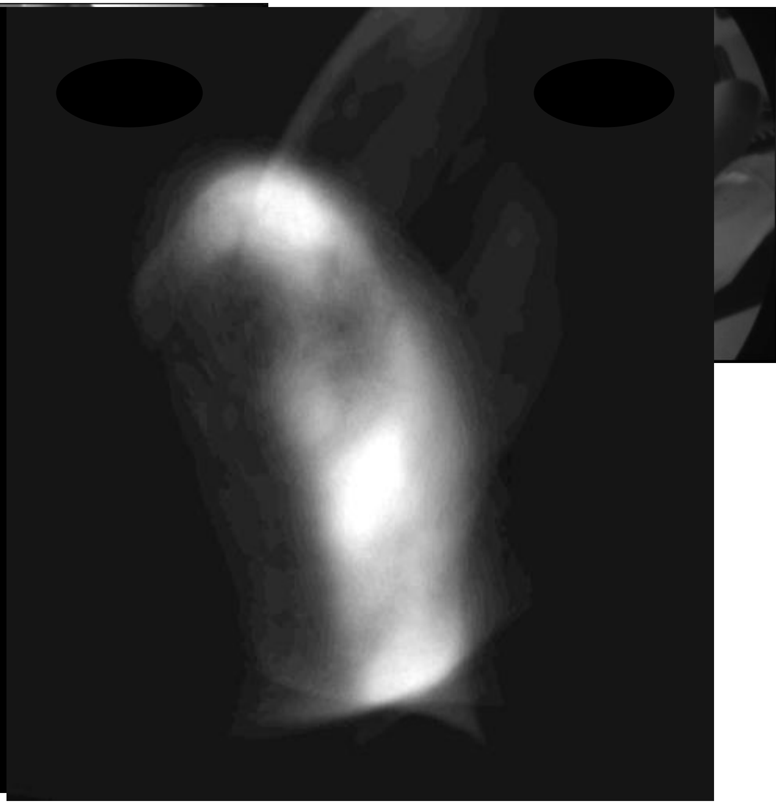
Cumulative image with NC fields



A Better Workflow for NC Plans







Conclusion

- MapRT provides a clearance map that can:
  - Replace the need for dry runs or manual checks
  - Improve treatment planning by providing the tools to create more complex plans without the risk of collisions.
- DoseRT allows dose visualization during treatment
  - Improved treatment safety
  - Monitor field delivery
  - Confirm patient positioning
  - Identify planning errors

Acknowledgements

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- VisionRT
- DoseOptics

Questions?

Thank you!

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