Monaco Webinar

Welcome!

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- **Linacs:**
  - 2 Elekta Versa HD with Agility MLC.
- **TPS:**
  - Monaco Ver. 5.1.

Agenda

- The case
- Isocenter and Volumes/rings
- Arc Geometry
- TPS parameters
- IMRT Constraints
- Results

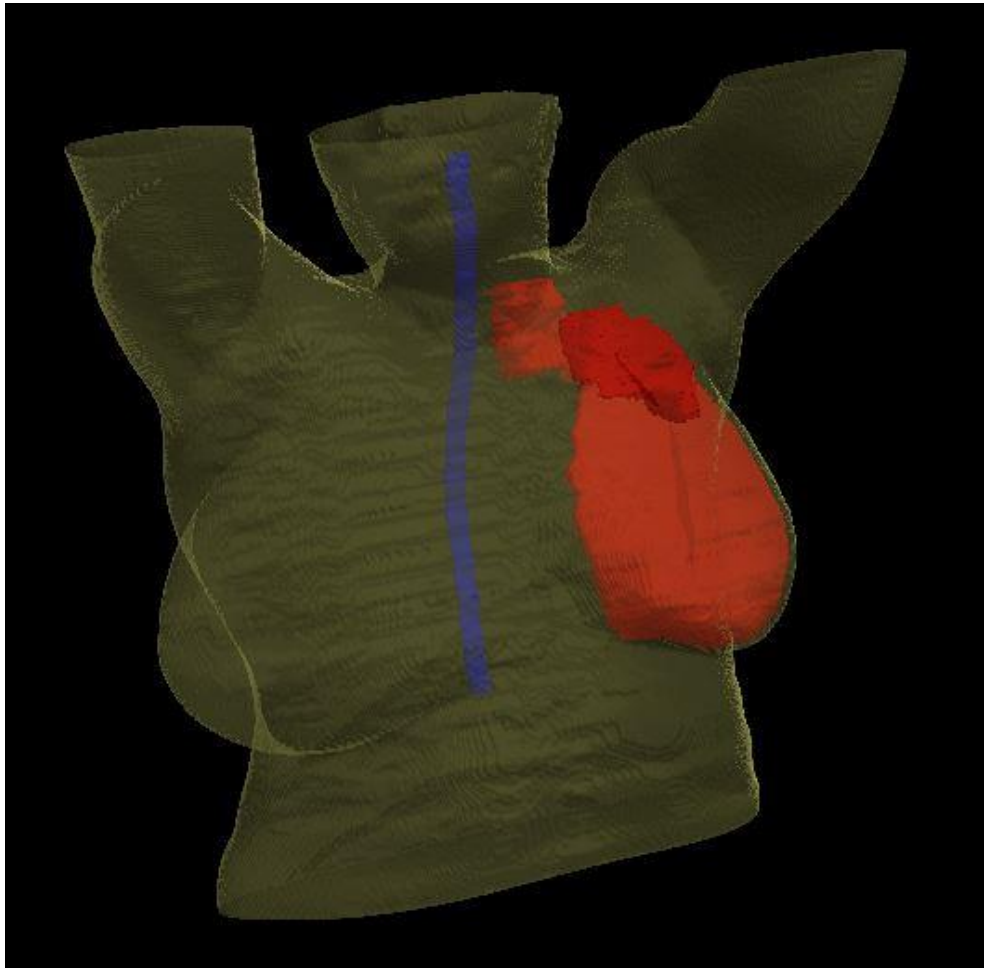
The case

Targets:

- PTV Right Breast
- PTV Axill
- PTV SC
- 50Gy in 25 fractions

Organs at risk:

- Lungs
- Heart
- Spinal Cord
- Right Breast



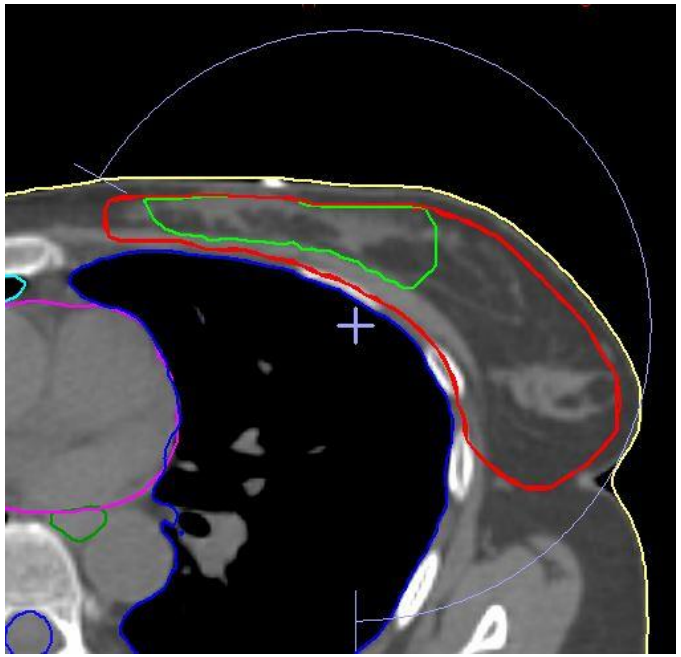
Isocenter and Volumes/rings

Isocenter:

Center of PTV Evaluation.

Volumes:

I didn't use auxiliar volume, rings.



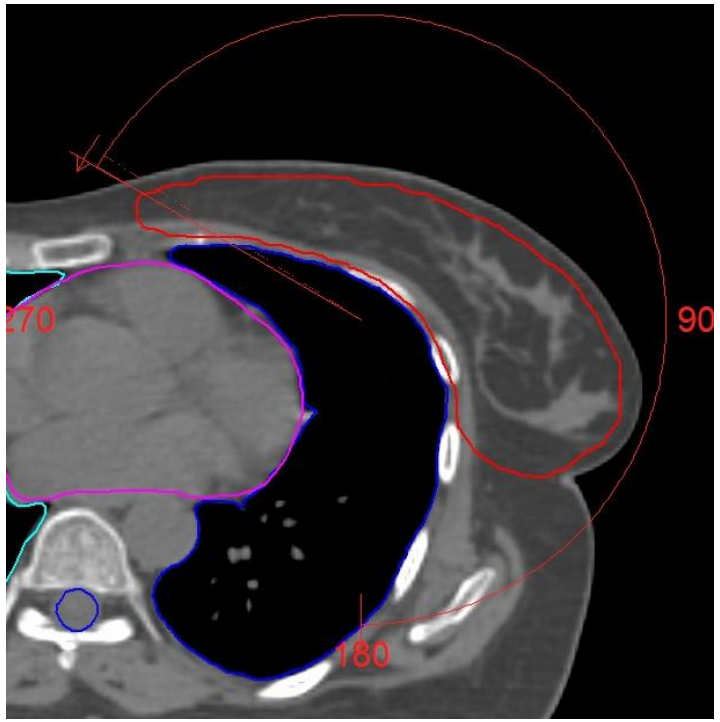
Arc Geometry

VMAT.

2 Fields with different energies.
(6MV and 10MV)

Arc1: Start – 300° End – 180°
Clock Wise with 6MV.

Arc2: Start – 180° End – 300°
Counter Clock Wise 10MV.



Beam	Description	SSD (cm)	Dir	Gantry (deg)	Arc	Inc	Collimator (deg)	Couch (deg)	Field	Margin (cm)	Asym
1		91.36	CW	300.0	240.0	10.0	0.0	0.0	[Auto]	1.00	☑
2		85.55	CCW	180.0	240.0	10.0	0.0	0.0	[Auto]	1.00	☑

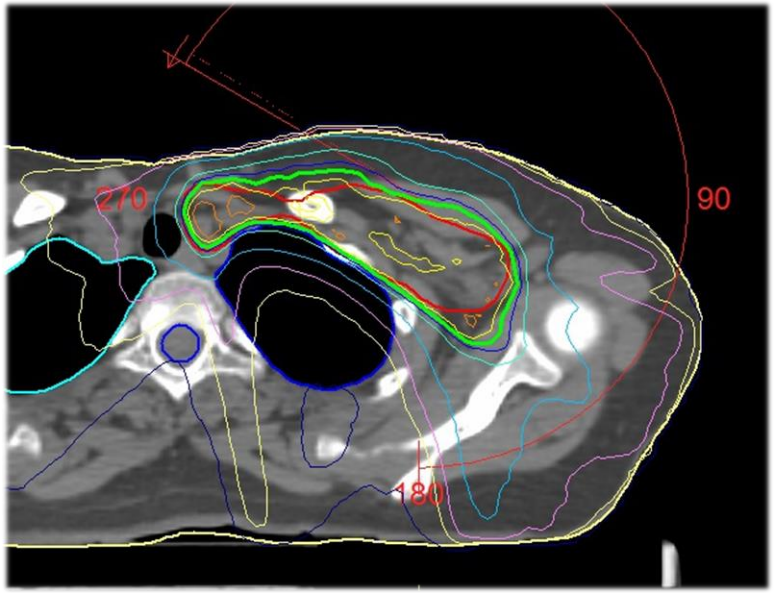
Arc Geometry

The start angle (300°) was chosen to spare contralateral OAR's (like a tangential field).

The finish angle(180°) was chosen to improve dose in the supraclavicular dose.

The field with 10MV was very helpful to decrease hotspots and improve PTV covering in deeper zones.

The "Agility" MLC has Jaw tracking. To be active in modulation, the field size must be in "auto" mode.



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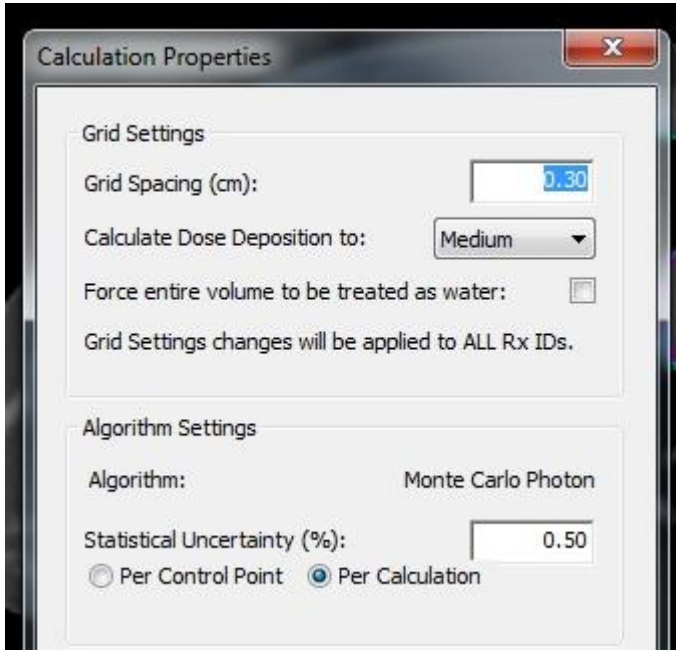
2		85.55	CCW	180.0	240.0	10.0	0.0	0.0	[Auto]	1.00	☑

TPS parameters

Monaco has multiple parameters that interferes in VMAT segmentation.

Calculation properties:

- Dose to medium was used (more close to reality).
- The grid spacing was 3mm, as CT slices.
- Statistical Uncertainty 0,5% per calculation was used.



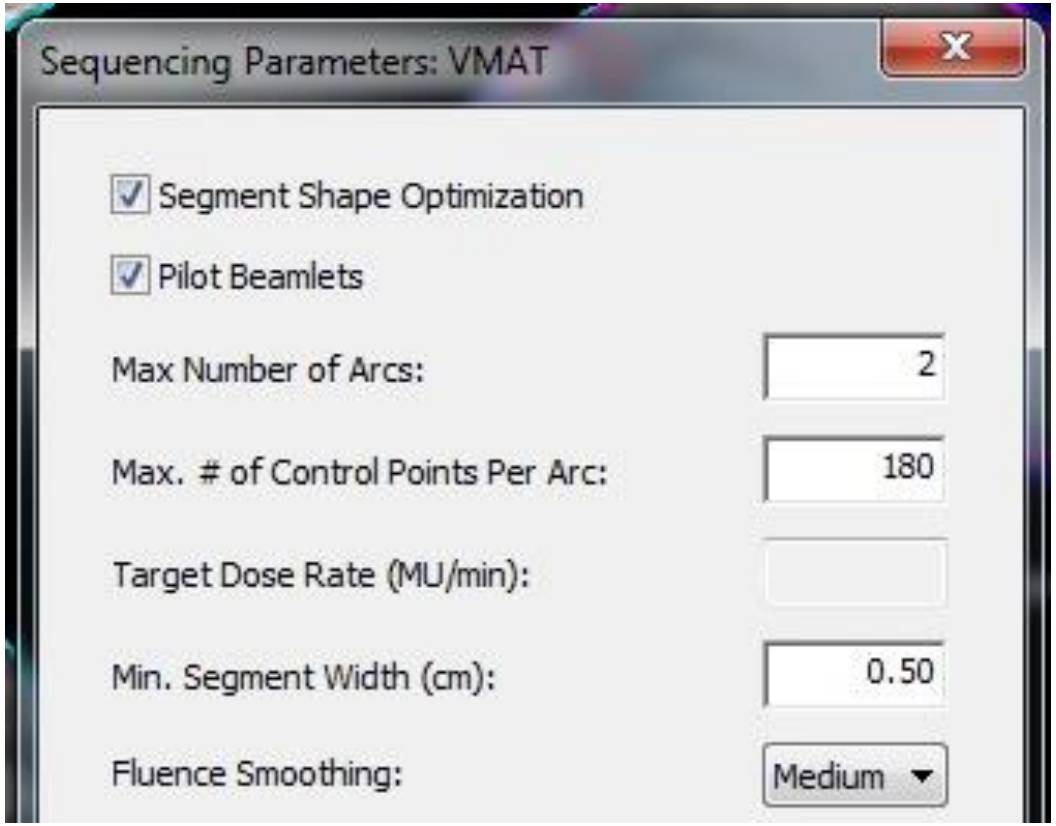
TPS parameters

Sequencing Parameters:

In Monaco each field can have more than one arc. The maximum number of arcs was defined as 2 per field (the 2 fields can have 4 arcs).

Maximum number of control points per arcs was defined as180, Monaco used 153 and 158 respectively.

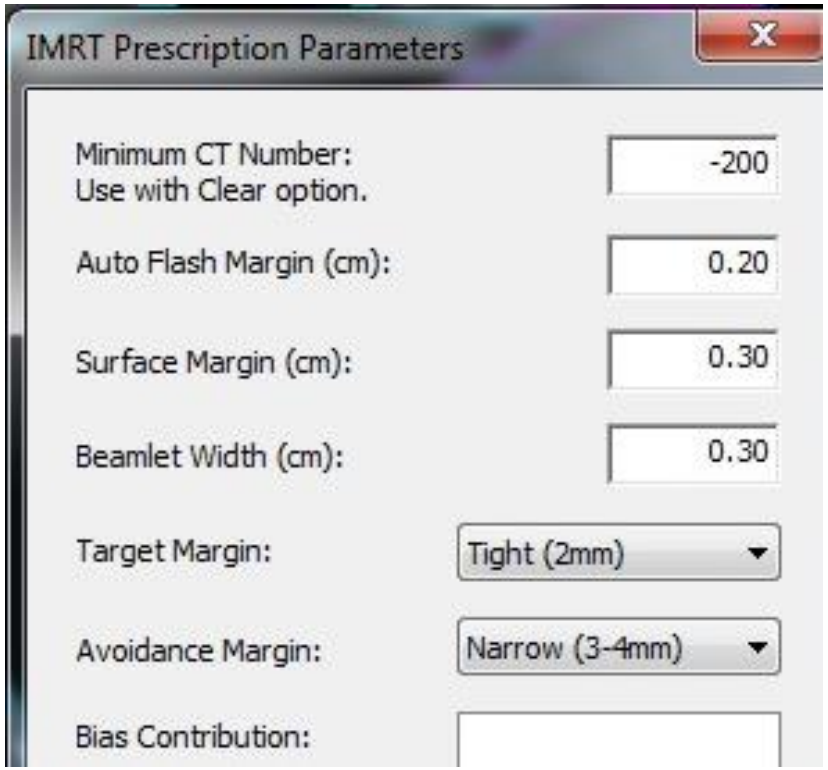
Minimum segment was defined according to an acceptable value (0,5cm)



TPS parameters

IMRT Prescription Parameters:

The only relevant parameter in this section is target margin, which was defined as “Tight” to not compromise PTV.



IMRT Constraints

IMRT Constraints

Pareto | Constrained | IMRT Parameters

Structure	Cost Function	Enabled	Status	Manual	Weight	Reference Dose (Gy)	Multicriterial	Isoconstraint	Isoeffect	Relative Impact
PTV_TOT_EVAL	Target Penalty	☑	On	☐	1.00			50.000	45.142	
	Maximum Dose	☑	On	☐	12.50			55.000	54.884	+++
	Quadratic Overdose	☑	On	☐	0.01	51.000		1.000	0.640	
LUNG_RIGHT	Serial	☑	On	☐	169.19		☐	4.000	3.993	++++
LUNG_LEFT	Serial	☑	On	☐	7.52		☐	10.000	10.339	+++
	Overdose DVH	☑	On	☐	264.11	15.000	☐	20.00	19.04	++++
HEART	Serial	☑	On	☐	854.81		☐	4.000	4.148	++++
	Overdose DVH	☑	On	☐	0.02	15.000	☐	13.00	2.93	
	Overdose DVH	☑	On	☐	0.01	20.000	☐	5.00	2.05	
SPINAL CORD	Maximum Dose	☑	On	☐	0.02			8.000	7.976	+
BREAST_RIGHT	Maximum Dose	☑	On	☐	1.82			6.000	5.982	++
BODY	Conformality	☑	On	☐	0.01		☐	0.65	0.27	
	Quadratic Overdose	☑	On	☐	0.01	47.500	☐	0.300	0.146	

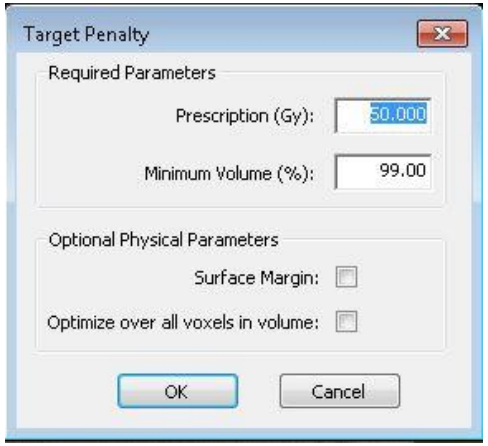
IMRT Constraints

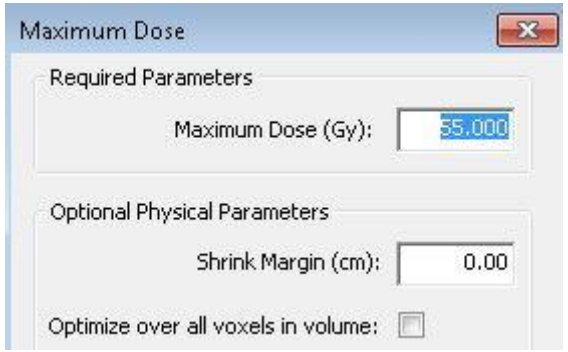
PTV_TOT_EVAL

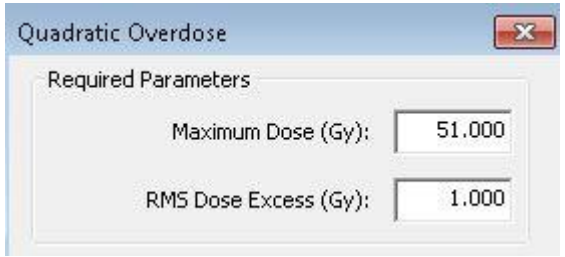
Target Penalty - defines dose and minimum volume coverage.

Maximum Dose – control hotspots, very rigid constraint.

Quadratic overdose- defines maximum dose but less rigid than "maximum dose".





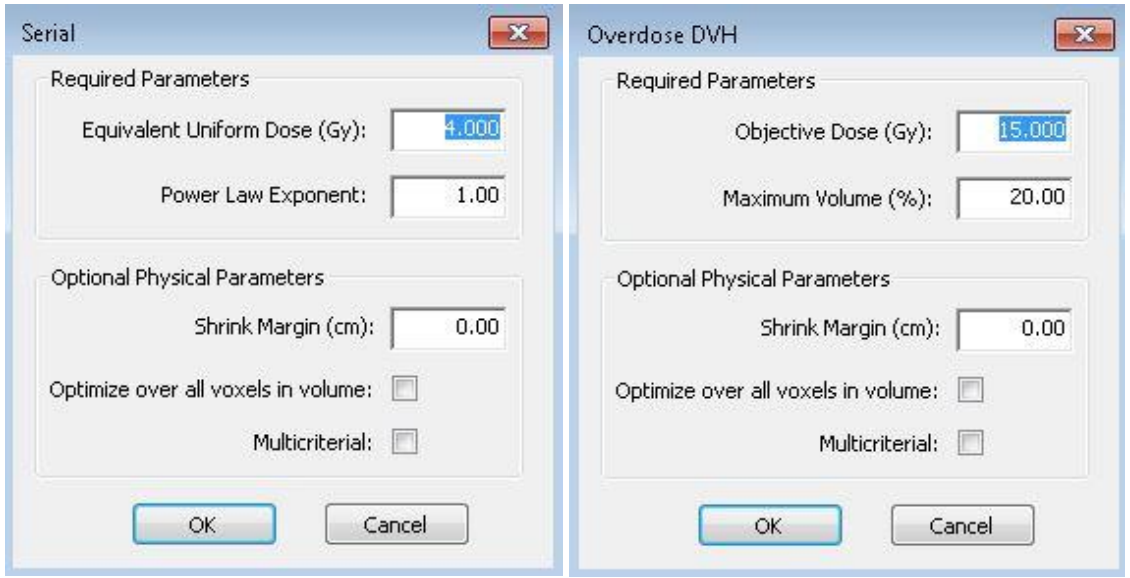


IMRT Constraints

Lungs e Heart

In both lungs and heart cost function **serial** was used to same propose. The “K” power law exponent was defined as “1” to control the volume average dose.

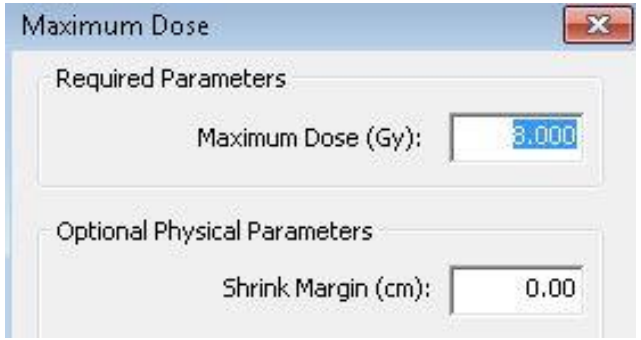
In left lung and heart **Overdose DHV** was used to control an objective dose to a certain volume.

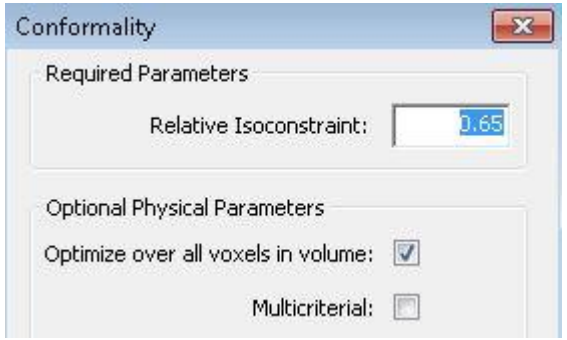


IMRT Constraints

Spinal cord and Right Breast

Only **Maximum Dose** was used.

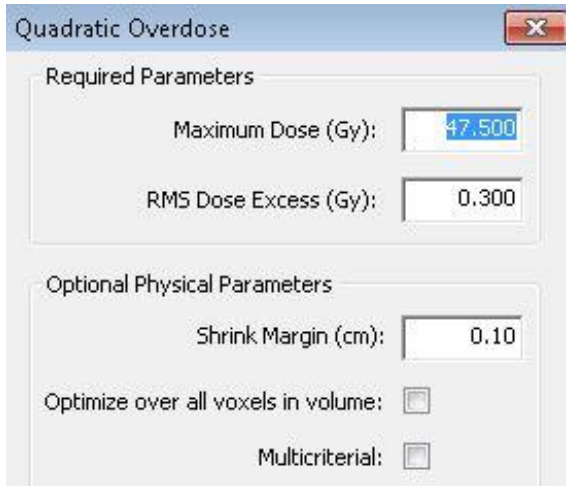




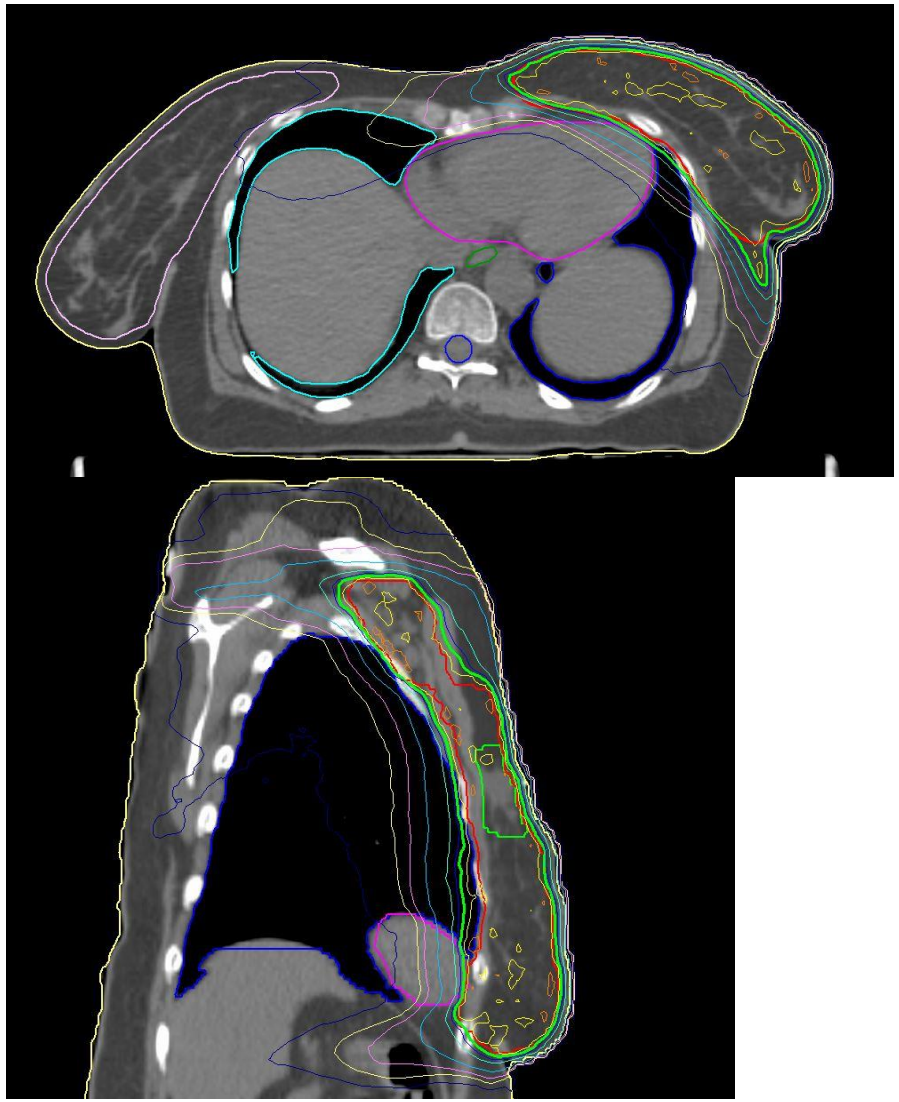
Body

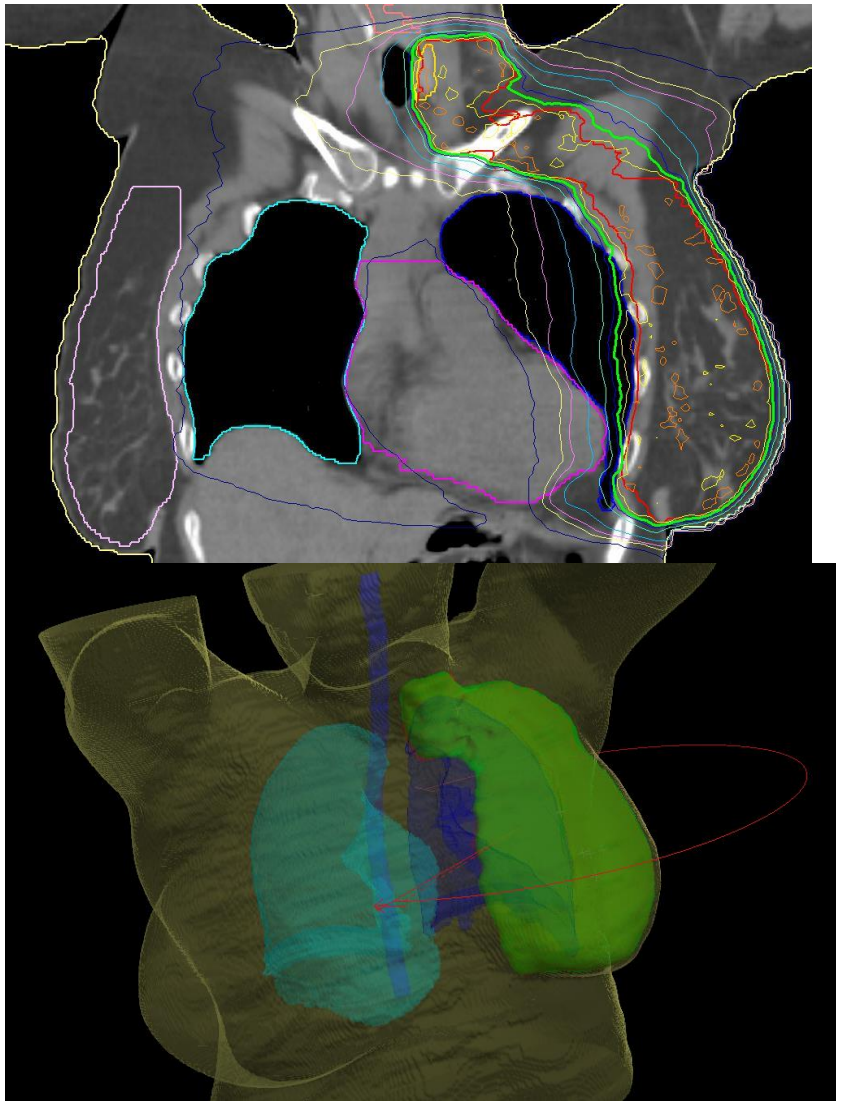
Quadratic overdose was used to act like a ring. It was used to control high dose outside PTV.

Conformality was used to increase dose gradient from PTV to Body.

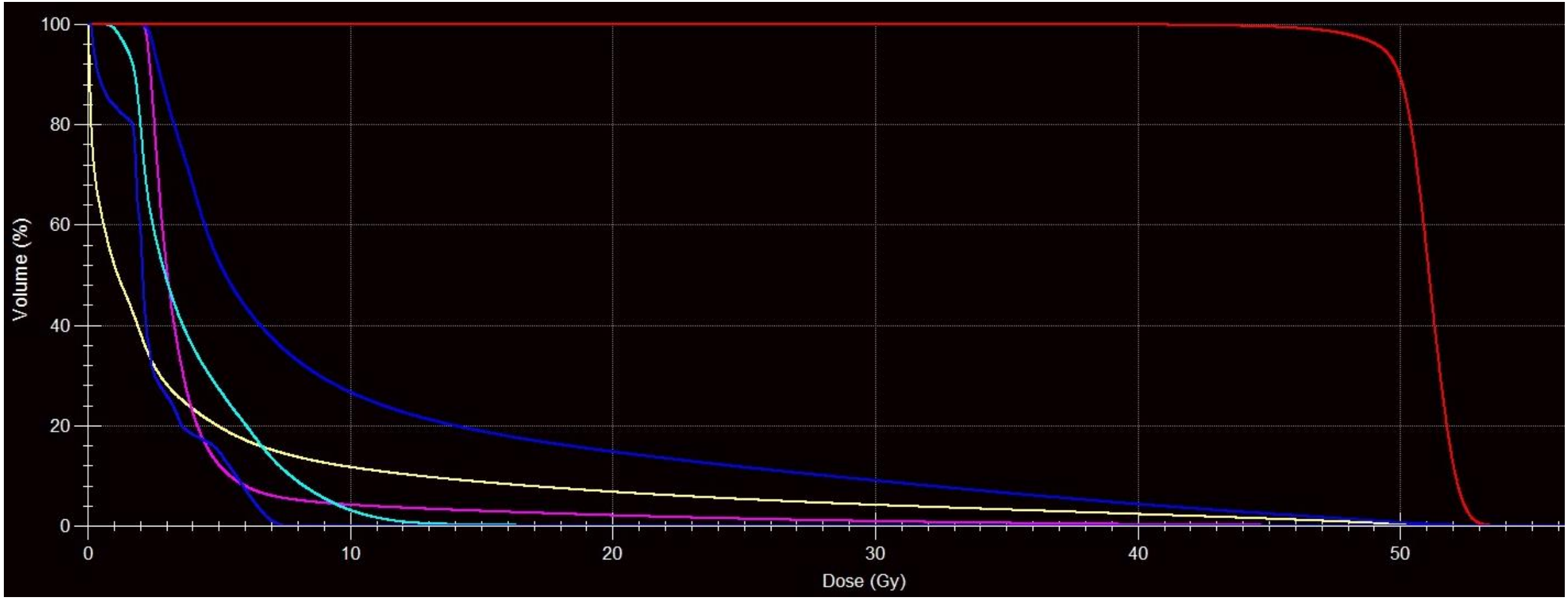


Results - Final Result





Results - HDV



Results - SCORE

Plan Quality Metric Component	Objective(s)	Result	Raw Score	Max Score	Performance
[PTV_TOT_EVAL] D[99.0%] (Gy)	> 45 [≥ 47.5]	47.6246	15.00	15.00	100.0%
[PTV_TOT_EVAL] D[95.0%] (Gy)	> 45 [≥ 50]	49.4779	4.48	5.00	89.6%
[PTV_TOT_EVAL] D[50.0%] (Gy)	< 54 [≤ 52]	51.1470	5.00	5.00	100.0%
[PTV_TOT_EVAL] D[0.3cc] (Gy)	< 57 [≤ 55]	54.2789	5.00	5.00	100.0%
[HEART] Mean dose (Gy)	< 5 [≤ 4]	4.1259	8.74	10.00	87.4%
[HEART] V[15.0Gy] (%)	< 20 [≤ 15]	2.8940	5.00	5.00	100.0%
[HEART] D[5.0%] (Gy)	< 25 [≤ 20]	7.9446	5.00	5.00	100.0%
[BREAST_RIGHT] D[0.3cc] (Gy)	< 3 [≤ 2]	5.9145	0.00	2.00	0.0%
[BREAST_RIGHT] D[5.0%] (Gy)	< 3 [≤ 2]	4.7950	0.00	4.00	0.0%
[SPINAL CORD] D[0.03cc] (Gy)	< 20 [≤ 8]	7.3889	5.00	5.00	100.0%
[LUNG_RIGHT] V[5.0Gy] (%)	< 6 [≤ 3]	27.7857	0.00	5.00	0.0%
[LUNG_LEFT] Mean dose (Gy)	< 15 [≤ 9]	10.3638	3.86	5.00	77.3%
[LUNG_LEFT] V[20.0Gy] (%)	< 20 [≤ 15]	15.1884	4.81	5.00	96.2%
[LUNG_LEFT] V[10.0Gy] (%)	< 40 [≤ 30]	27.3033	5.00	5.00	100.0%
[LUNG_LEFT] V[5.0Gy] (%)	< 70 [≤ 50]	53.8890	2.83	4.00	70.8%
[PTV_TOT_EVAL] Homogeneity Index [50.0Gy]	< 0.2 [≤ 0.08]	0.1108	3.46	5.00	69.2%
[PTV_TOT_EVAL] Conformation Number [47.5Gy]	> 0.6 [≥ 0.9]	0.8174	4.17	5.00	83.5%
Global Max Location (ROI)	[BODY]	BODY	5.00	5.00	100.0%
Total [18 Metrics]			82.36	100.00	82.4%

THE END

Thank you

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