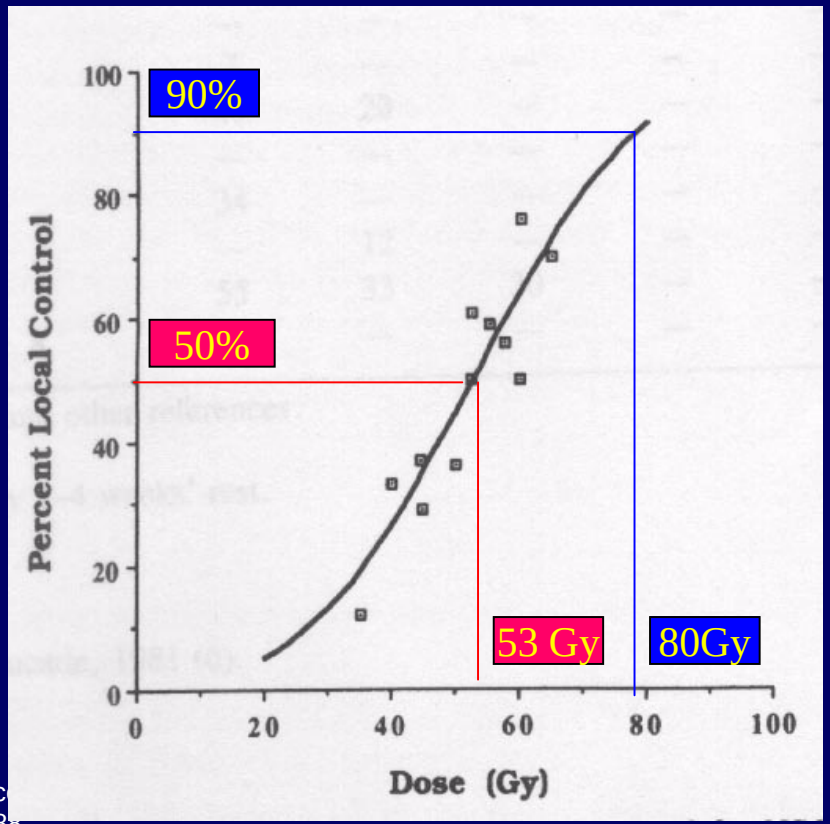
IMRT Decreased the Normal Lung Volume Irradiated Compared to 3DCRT in patients with NSCLC.

Hasan Murshed

Statement of Problem

- Correlation between dose and LC for NSCLC from published data.
- Increasing RT dose improves LC.



Vijayakumar et al. Int J Radiat Onc
Aug; 21(30): 779-88

Statement of Problem

- Results: in multivariate only V20 significant.

	Pneumonitis		
V20	gr 2	gr 3-5	fatal
(%)	(%)	(%)	(total pt)
< 22	0	0	
22-31	8	8	
32-40	13	5	1
> 40	19	23	3

- Concl:
  - Strong correlation between V20 and severity of pneumonitis.
  - V20 is a useful parameter to evaluate pneumonitis.

Graham et al. Int J Radiation Oncol Biol Phys 1999
Sep 1; 45(2): 223-9

Purpose

- To investigate the potential dosimetric improvements with respect to tumor coverage and normal-tissue sparing in using IMRT to 3DCRT for NSCLC.

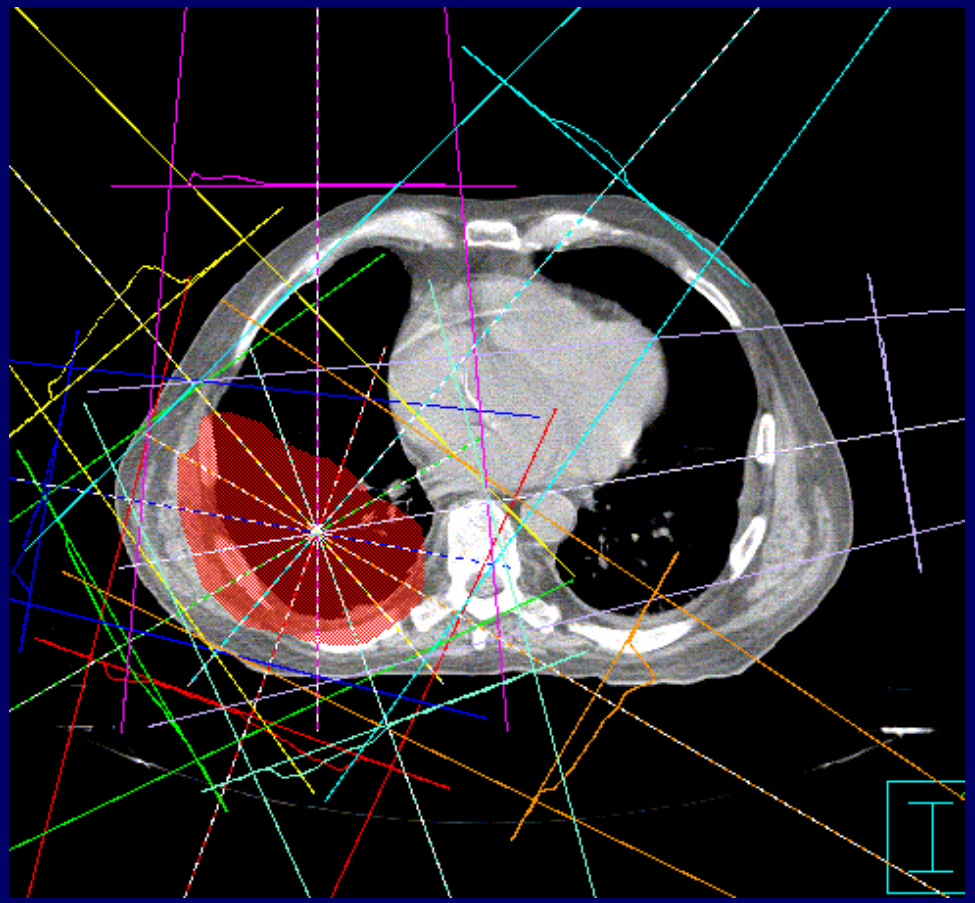
Materials and Methods

- Forty-one pts with LA NSCLC

- 3DCRT tech
  - CT simulations for all
  - 3-6 beams, 6 and 18 MV photons
  - 63 Gy to 95% of the PTV

Materials and Methods

- IMRT tech
  - 9 equispaced coplanar
  - 6 MV beams



Materials and Methods

- IMRT tech
  - Target volumes, isocenter, prescription same as 3D
  - Inverse planning used to optimize beam fluences
  - Leaf motion generated
  - Actual fluence used to calculate deliverable dose distribution
  - Heterogeneity correction, Pinnacle system

Materials and Methods

- Treatment Plan Evaluation

- Tumors/Treatment
  - Conformity Index CI = Vdp/Vptv
  - Heterogeneity Index HI = D5%/D95%
  - MUs

Materials and Methods

- Treatment Plan Evaluation

- Normal Lung
  - Volume treated above 5, 10, 20 Gy
  - Biologically effective volume, Veff
  - Mean Lung dose
  - Integral Lung dose

Materials and Methods

- Treatment Plan Evaluation

- Critical structures
  - Esophagus above 55 Gy
  - Heart above 45 Gy
  - Spinal cord above 45, 50, max

Materials and Methods

- Treatment Plan Evaluation

- Thoracic Norrnal Tissue
  - Volume enclosed by 5, 10, 20, 30, 40 Gy
  - Thoracic tissue Integral dose

Results

- 73 yom

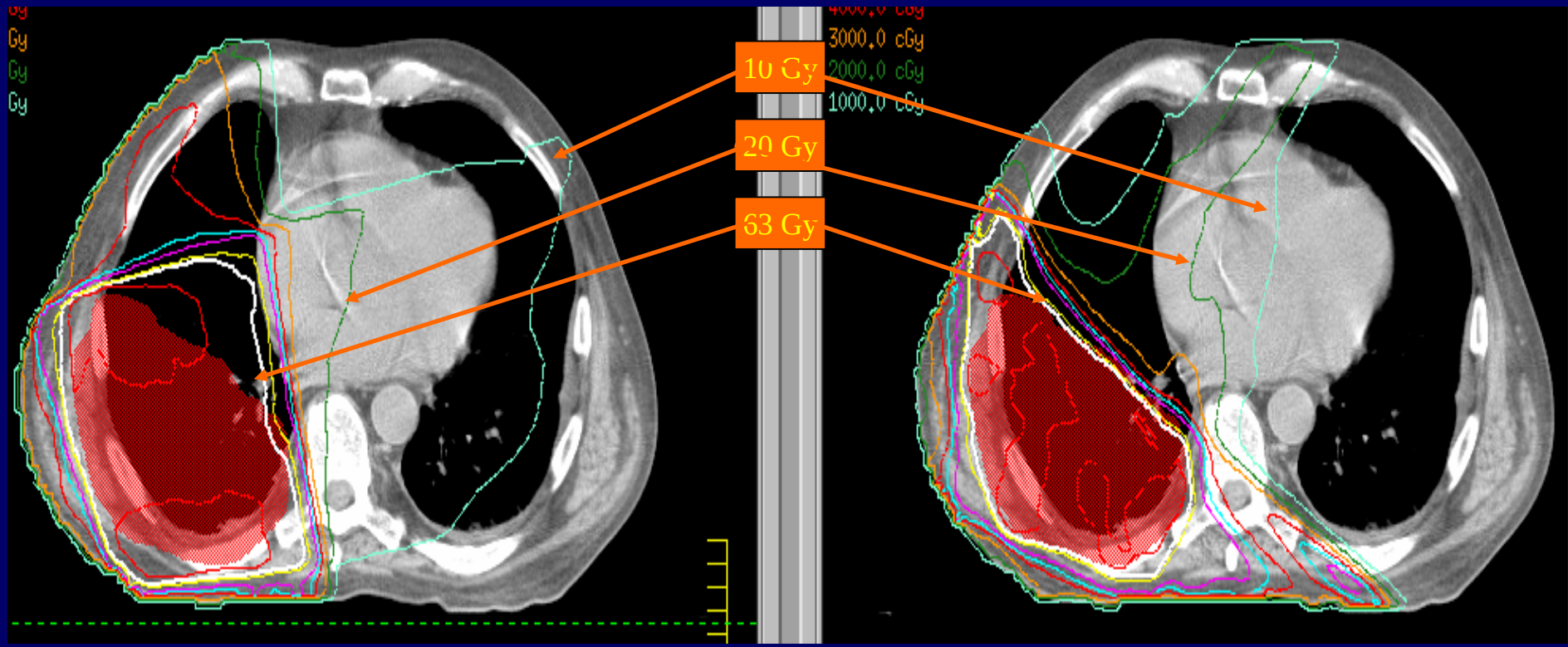
- RUL non-small cell cancer
- Recurrent SCCa

- GTV = 338 cc, PTV = 1108 cc

Results

- 3D

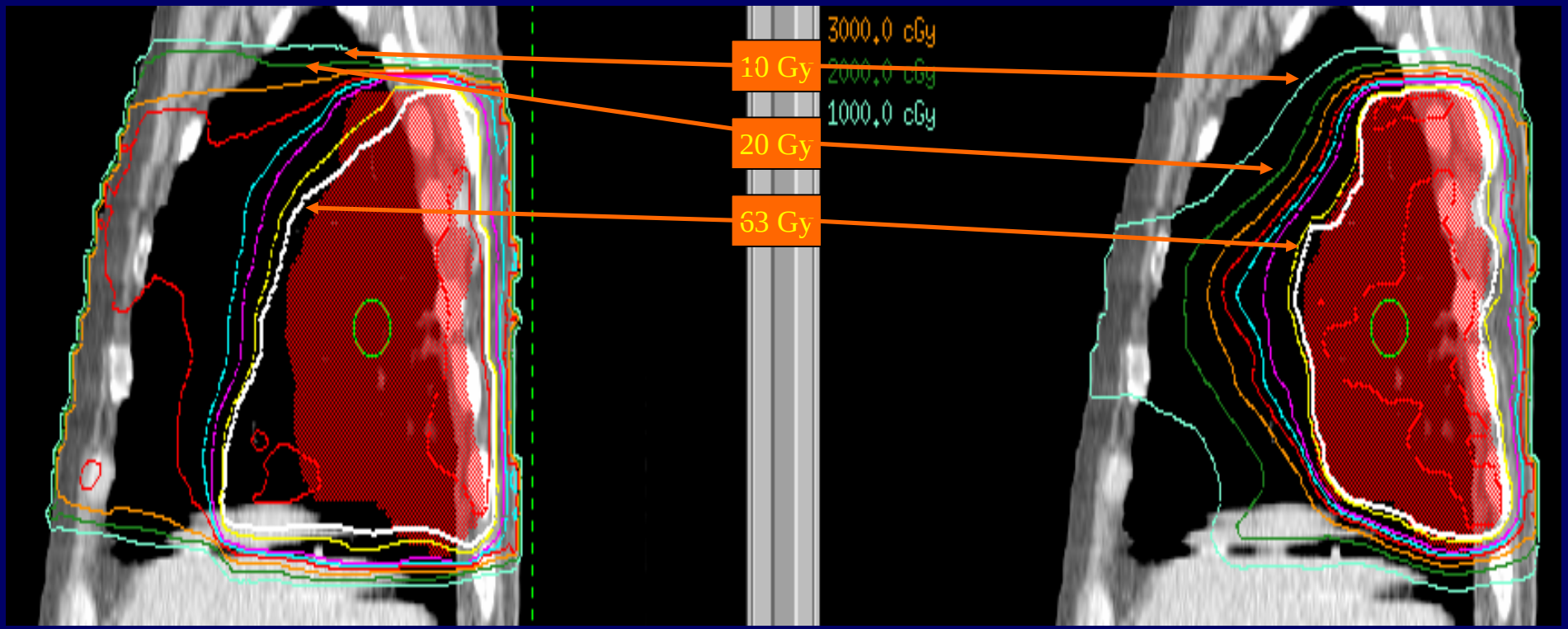
IMRT



Results

- 3D

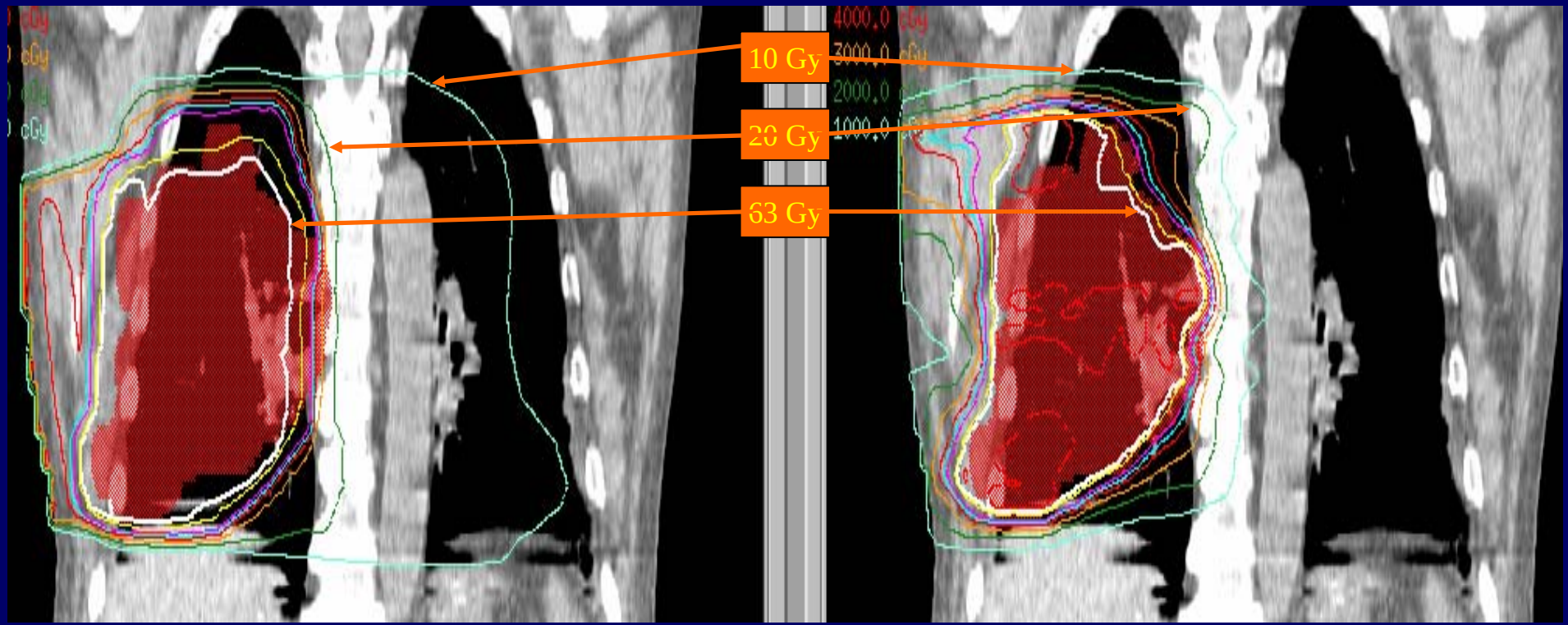
IMRT



Results

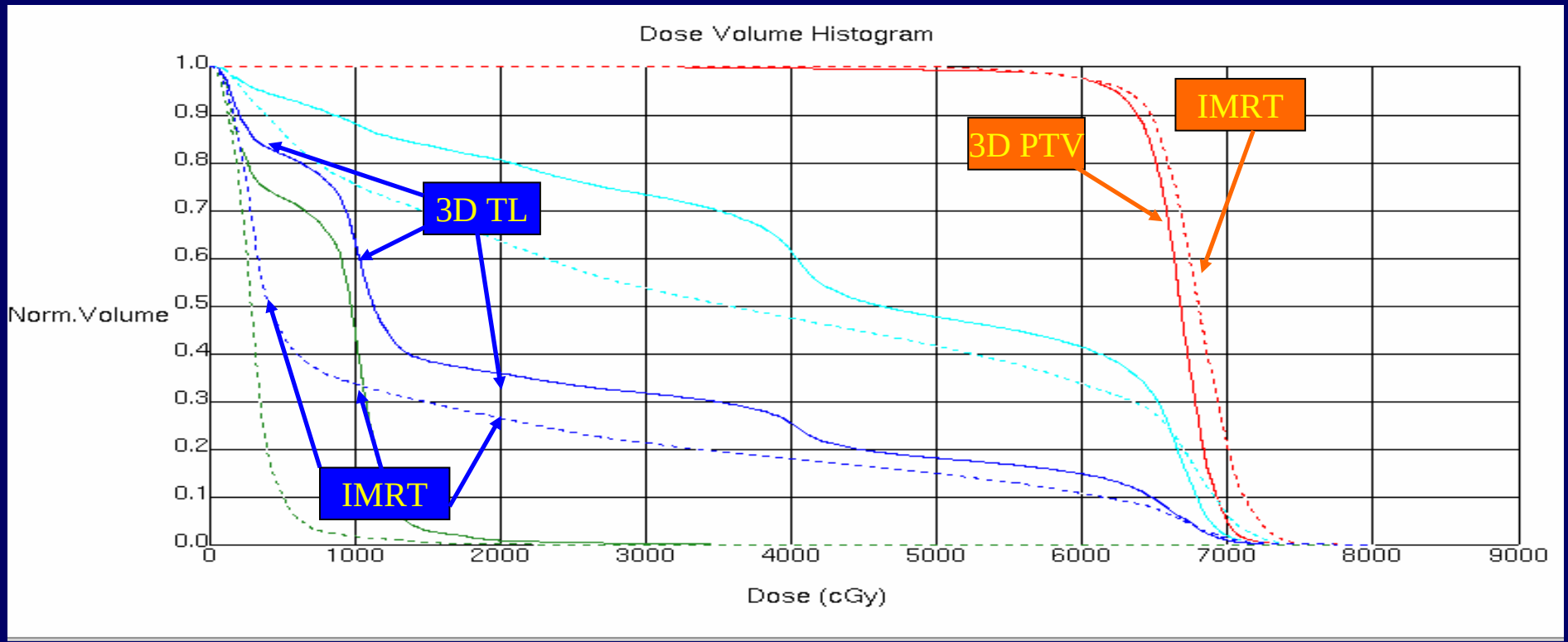
- 3D

IMRT



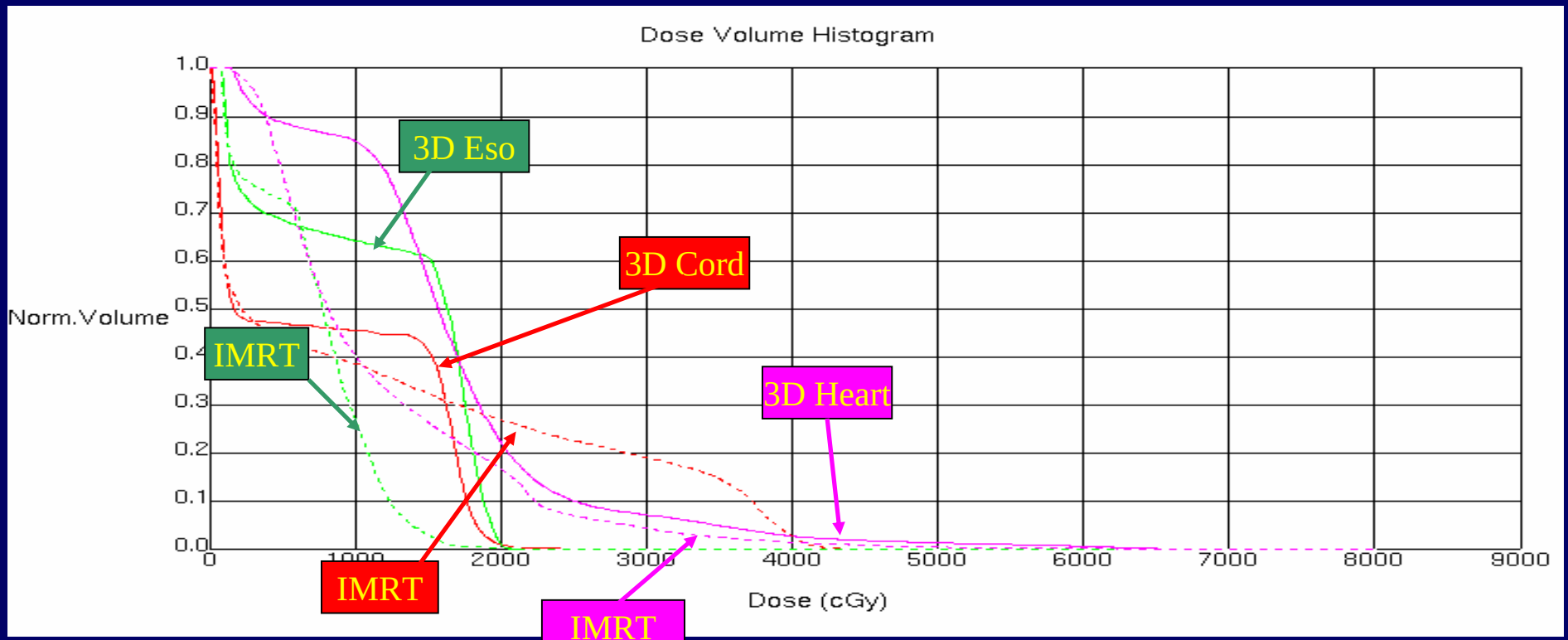
Results

- 3D/IMRT



Results

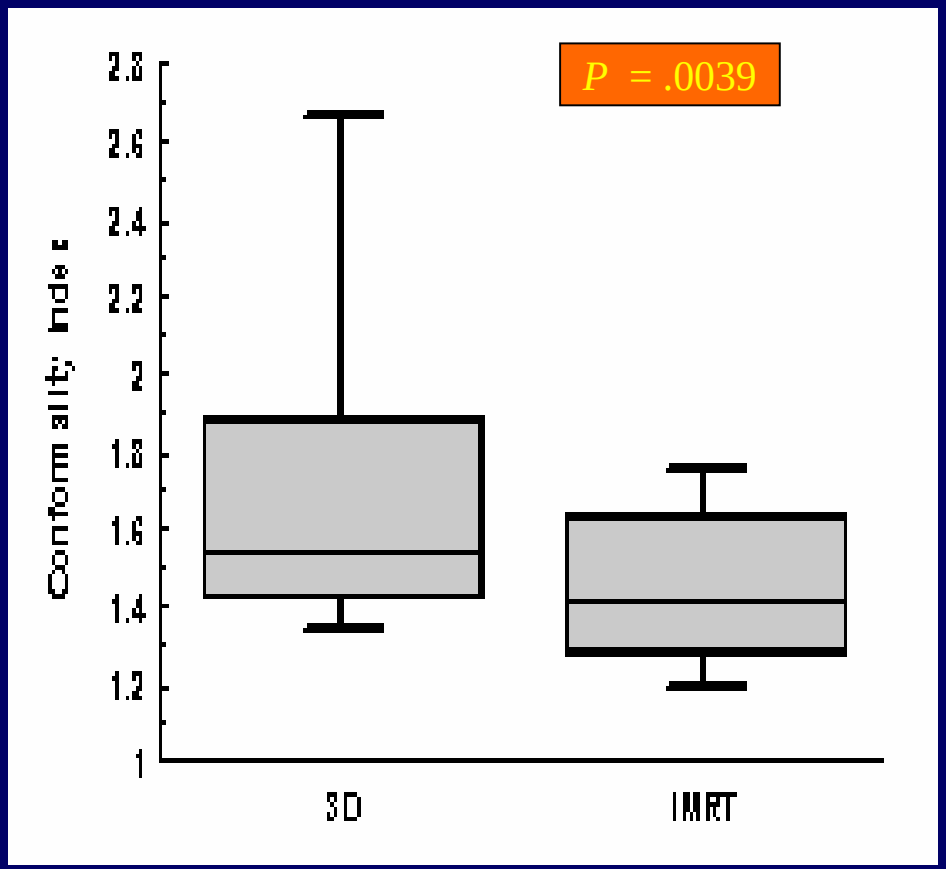
- 3D/ IMRT

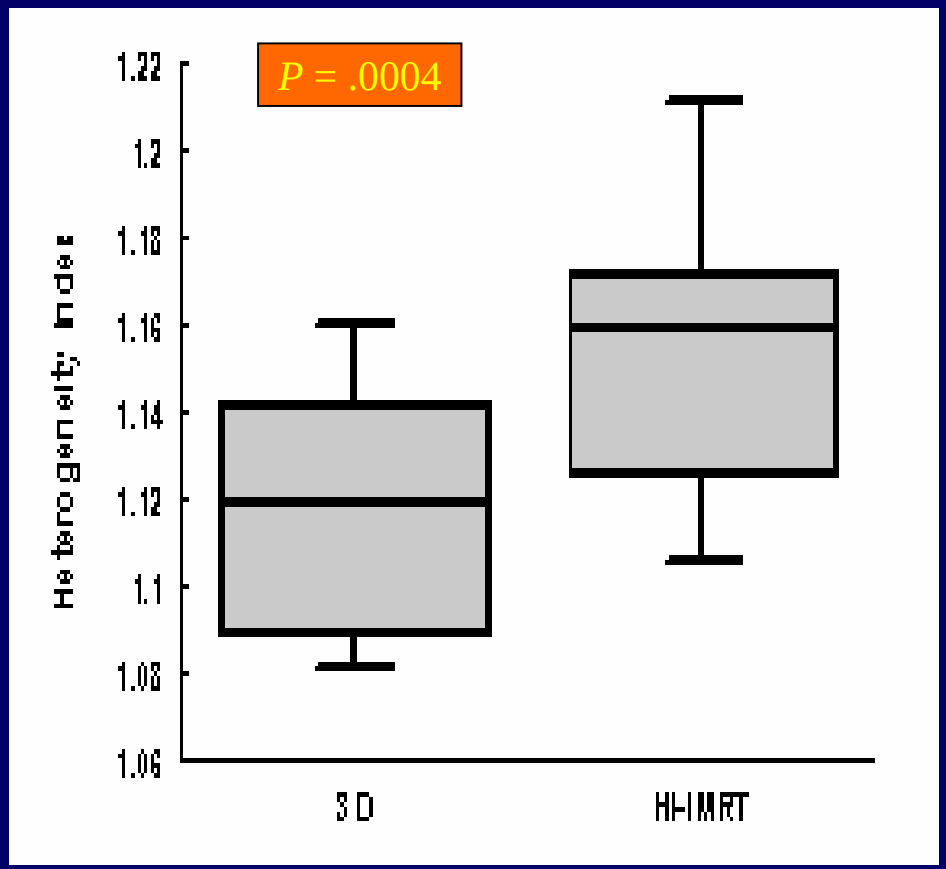


Results

Parameters	3D	IMRT	*p* value
	Median (range)	Median (range)	
Conformality Index	**1.54** (1.26-4.53)	**1.41** (1.06-2.09)	0.0039
Heterogeneity Index	**1.12** (1.06-1.22)	**1.16** (1.06-1.43)	0.0004
Monitor Units	**266** (166-991)	**1884** (953-3838)	< 0.0001

Results

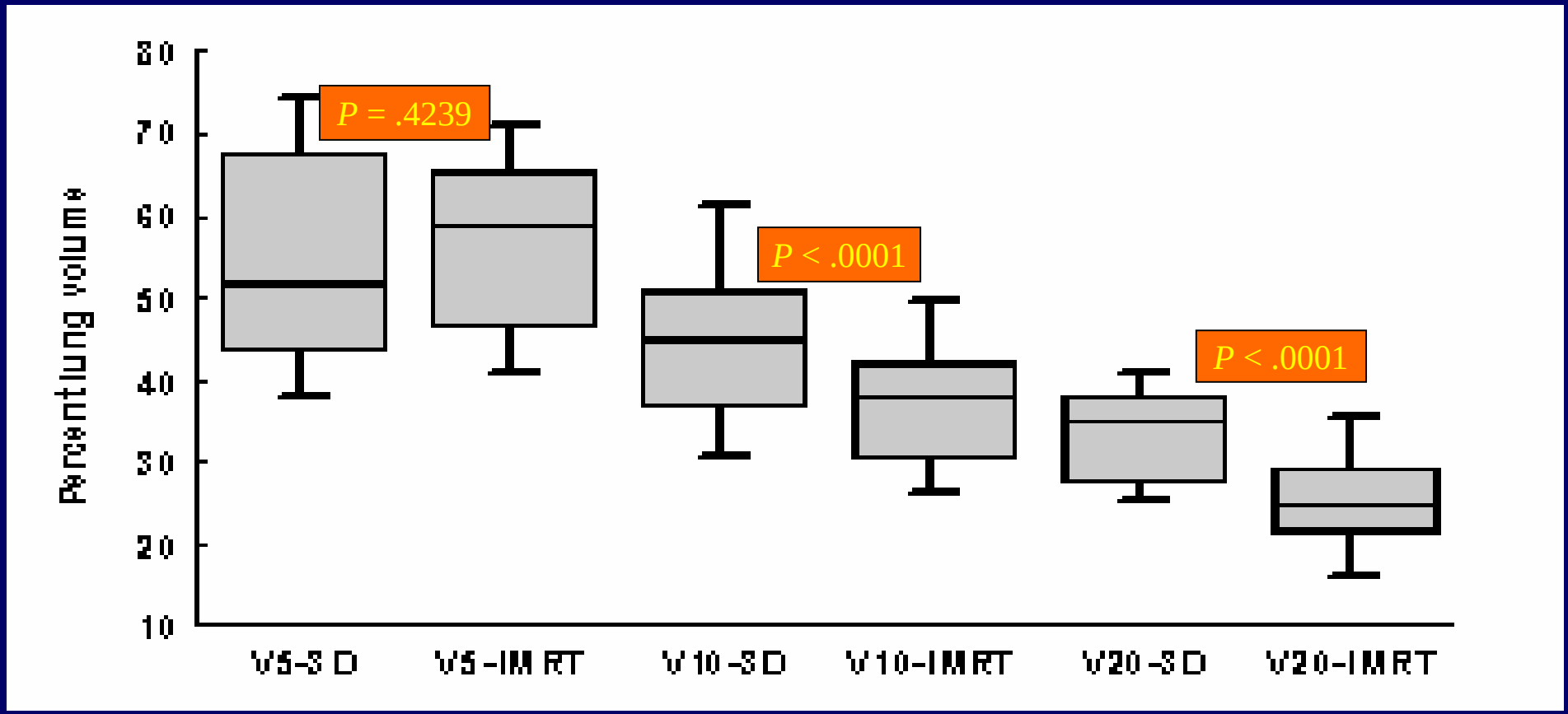

P = .0039
Conformality Index
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
3D
IMRT


P = .0004
Heterogeneity Index
1.22
1.2
1.18
1.16
1.14
1.12
1.1
1.08
1.06
3D
HI-IMRT

Results

Parameters	3D	IMRT	*p* value
	Median (range)	Median (range)	
Total Lung V5 (%)	**52** (27.93-86.00)	**59** (25.00-78.00)	0.4239
Total Lung V10 (%)	**45** (21.99-64.00)	**38** (18.00-59.00)	< 0.0001
Total Lung V20 (%)	**35** ((16.88-54.63)	**25** (13.00-42.620	< 0.0001
Total Lung Veff (%)	**70.96** (32.52-101.13)	**57.63** (27.75-94.68)	< 0.0001
Total Lung Mean Dose (Gy)	**19.21** (10.07-29.06)	**17.20** (8.76-26.92)	< 0.0001
Total Lung Integral Dose (J)	**18.62** (5.26-36.42)	**15.82** (4.58-33.6)	< 0.0001

Results


Percent lung volume
80
70
60
50
40
30
20
10
P = .4239
P < .0001
P < .0001
V5-3D
V5-IMRT
V10-3D
V10-IMRT
V20-3D
V20-IMRT

Results

- Improvement of V10, V20 and TLMD with IMRT were analyzed as a function of
  - tumor location - right, left, upper, lower
  - tumor sizes - GTV, PTV

- No parameters had significant effect on lung sparing

Results

Parameters	3D	IMRT	*p* value
	Median (range)	Median (range)	
Esophagus (% cc at 55Gy)	**35** (0.00-72.00)	**28.82** (0.00-71.00)	< 0.0001
Heart (% cc at 40 Gy)	**13** (0.00-58.00)	**11** (0.00-59.00)	0.0036
Spinal cord (% cc at 45 Gy)	**0.010** (0.00-33.00)	**0.900** (0.00-31.00)	0.0261
Spinal cord (Maximum dose	**45.8** (10.60-55.40)	**48.6** (38.60-63.20)	0.0002

Results

Parameters	3D	IMRT	*p* value
	Median (range)	Median (range)	
Thoracic Normal Tissue V5 (cc)	**5658** (3040.30-11596.00)	**6929** (2759.00-10788.00)	0.0064
Thoracic Normal Tissue V20 (cc)	**3919** (1919.00-6776.00)	**3398** (1509.00-6535.00)	0.0014
Thoracic Normal Tissue V40 (cc)	**3213** (1560.00-5489.00)	**2673** (1242.00-5402.00)	< 0.0001
Thoracic Normal Tissue Integral D	**180.46** (87.97-311.92)	**185.71** (72.32-13511.00)	0.7805

Conclusions

- IMRT planning significantly improved target coverage
- Reduced the volume of normal lung irradiated
- Reduced the volume of critical structures

Conclusions

- IMRT appears to be a viable option for treating NSCLC with the possibility of additional reduction of the normal tissue toxicity and/or dose escalation.

Conclusions

- Future Plan

- Reduce the number of radiation beams
  - to significantly decrease V5
  - while maintaining other goals of treatment

- Clinical implementation of IMRT for NSCLC
  - via protocol at MDA