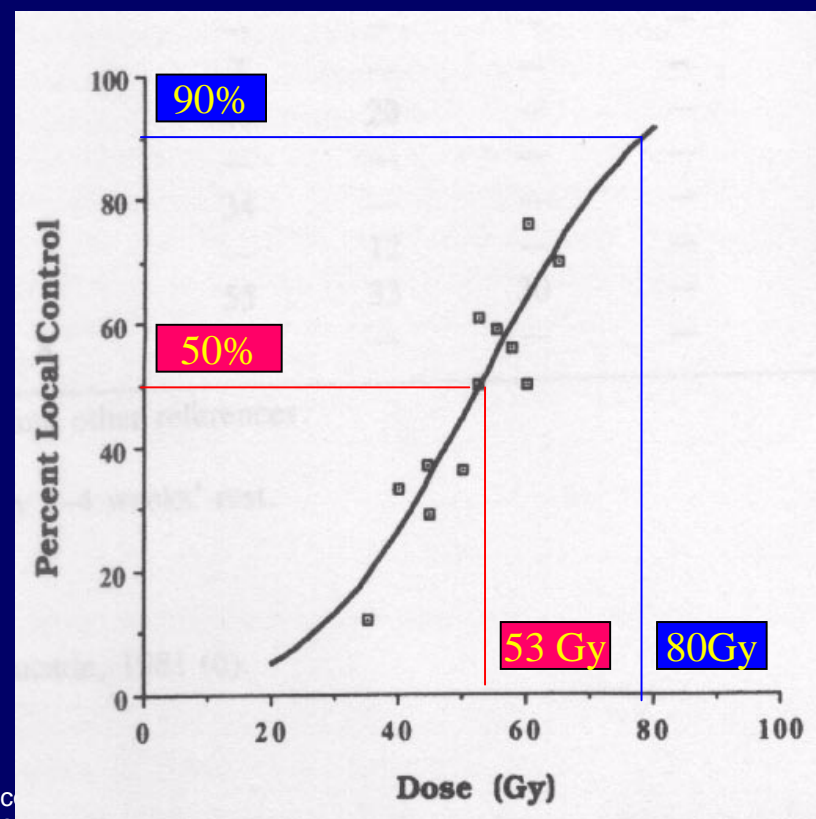


IMRT Decreased the Normal  
Lung Volume Irradiated  
Compared to 3DCRT in patients  
with NSCLC.

Hasan Murshed

# Statement of Problem

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



# 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.

# Purpose

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- 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

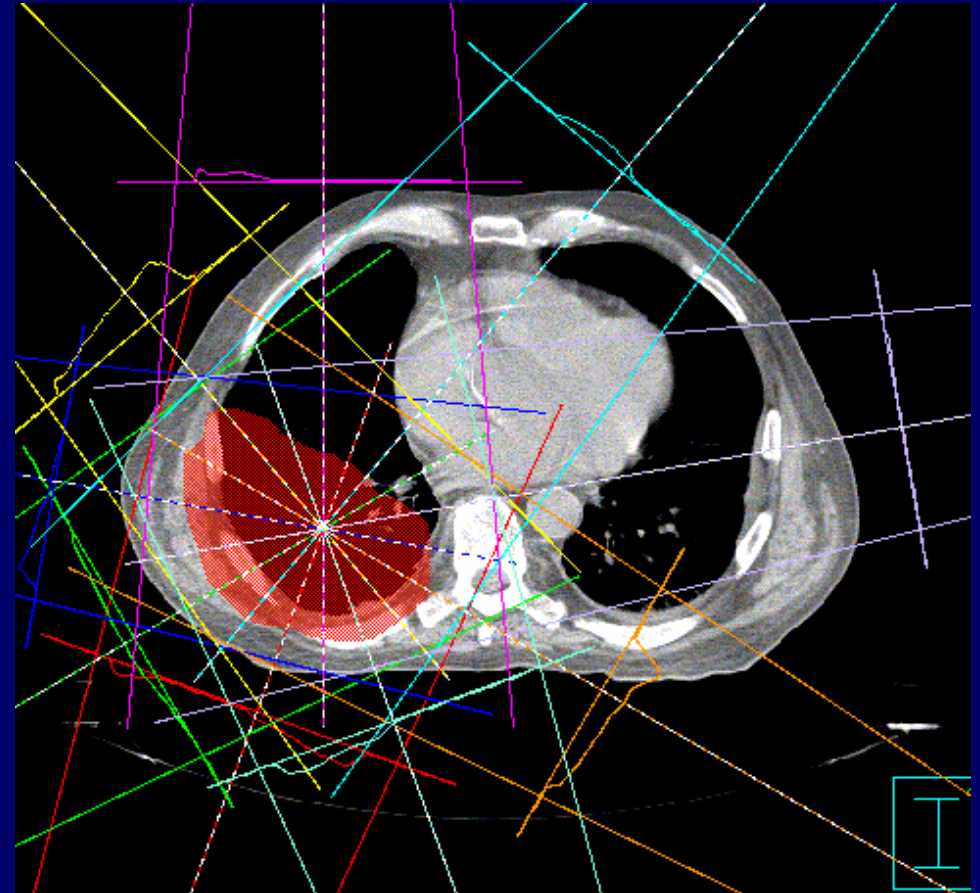
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- Forty-one pts with LA NSCLC
- 3DCRT tech
  - CT simulations for all
  - 3-6 beams, 6 and 18 MV photons
  - 63 Gy to 95% of the PTV

# Materials and Methods

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- IMRT tech
  - 9 equispaced coplanar
  - 6 MV beams



# Materials and Methods

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- 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

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- Treatment Plan Evaluation
- Tumors/Treatment
  - Conformity Index  $CI = V_{dp}/V_{ptv}$
  - Heterogeneity Index  $HI = D5\%/D95\%$
  - MUs

# Materials and Methods

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- Treatment Plan Evaluation
- Normal Lung
  - Volume treated above 5, 10, 20 Gy
  - Biologically effective volume,  $V_{eff}$
  - Mean Lung dose
  - Integral Lung dose

# Materials and Methods

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

# Materials and Methods

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- Treatment Plan Evaluation
- Thoracic Normal Tissue
  - Volume enclosed by 5, 10, 20, 30, 40 Gy
  - Thoracic tissue Integral dose

# Results

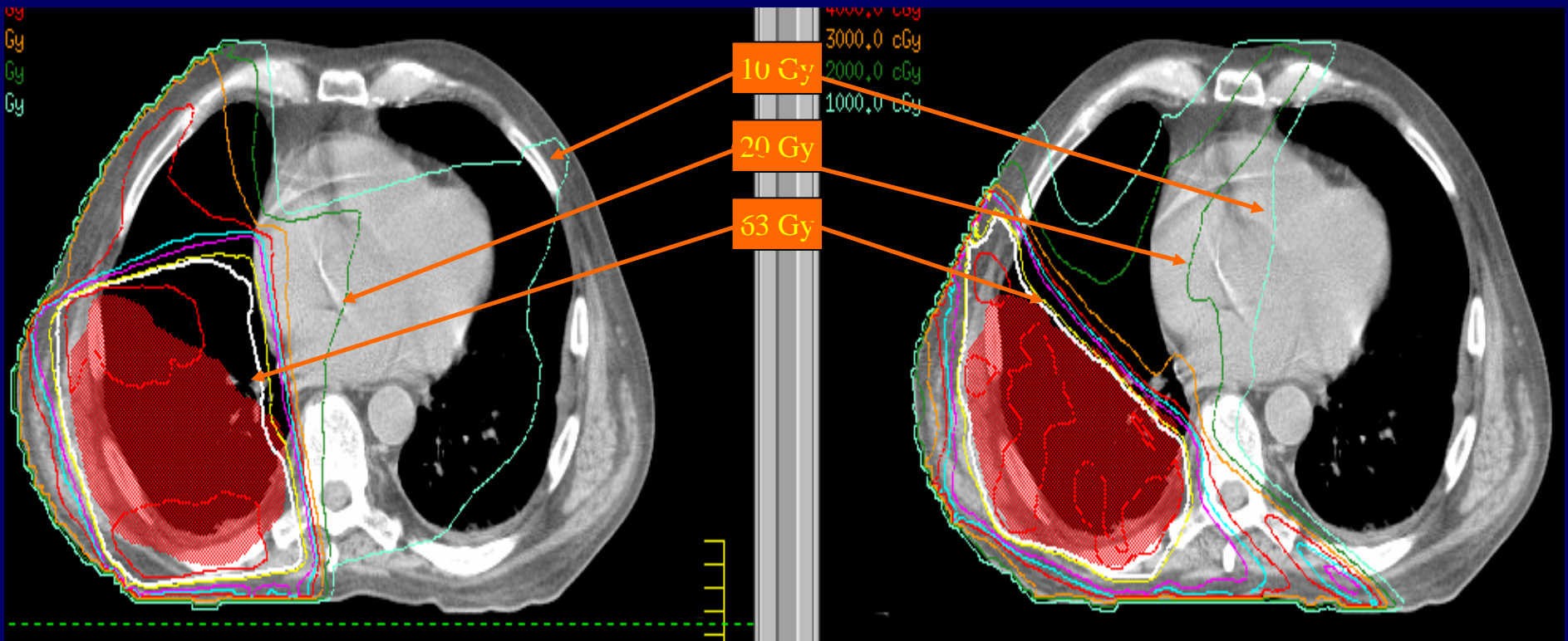
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- 73 yom
- RUL non-small cell cancer
- Recurrent SCCa
- GTV = 338 cc, PTV = 1108 cc

# Results

- 3D

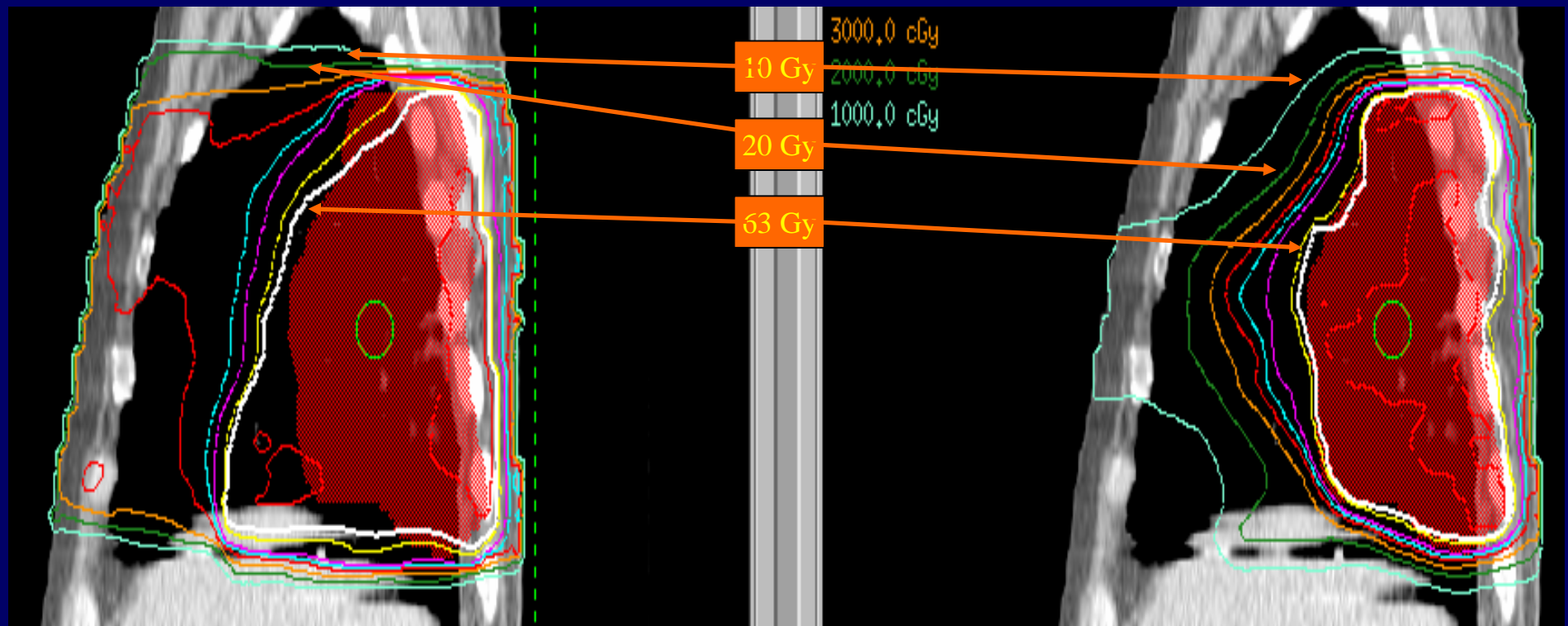
## IMRT



# Results

- 3D

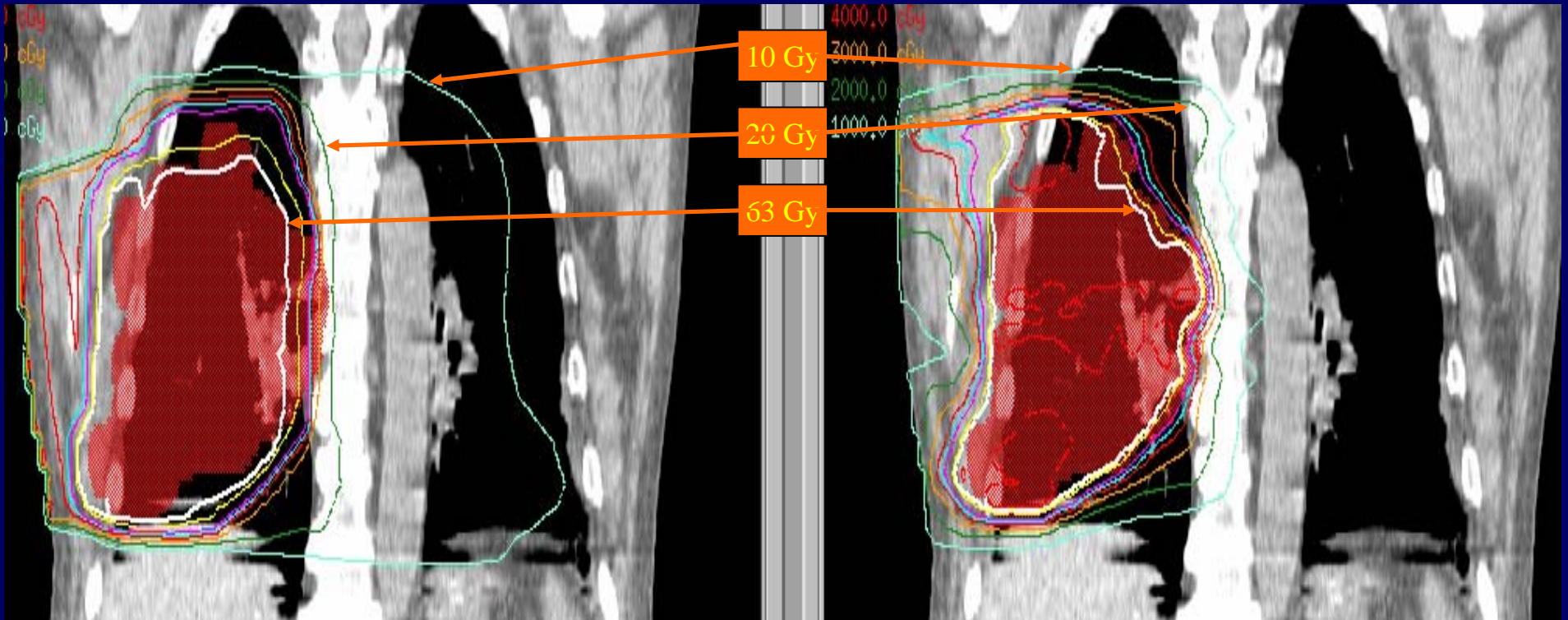
## IMRT



# Results

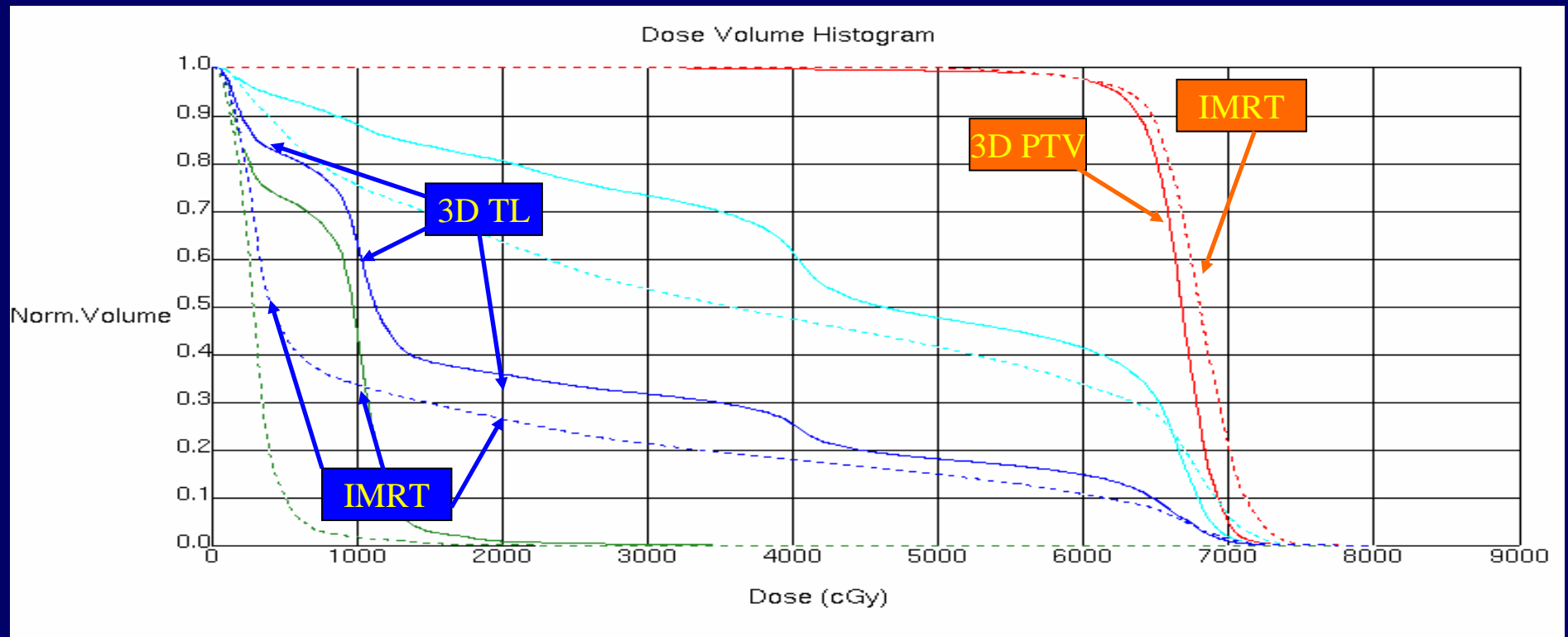
- 3D

IMRT



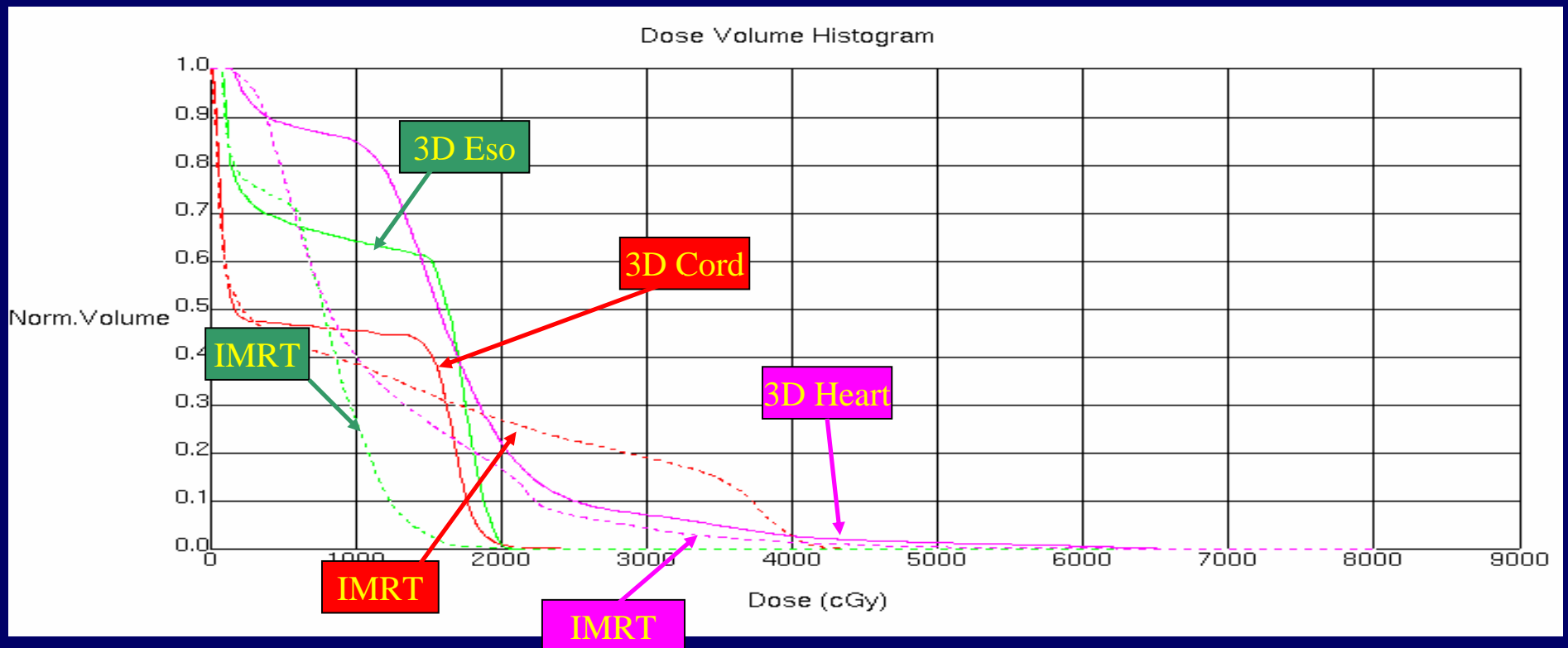
# Results

- 3D/IMRT



# Results

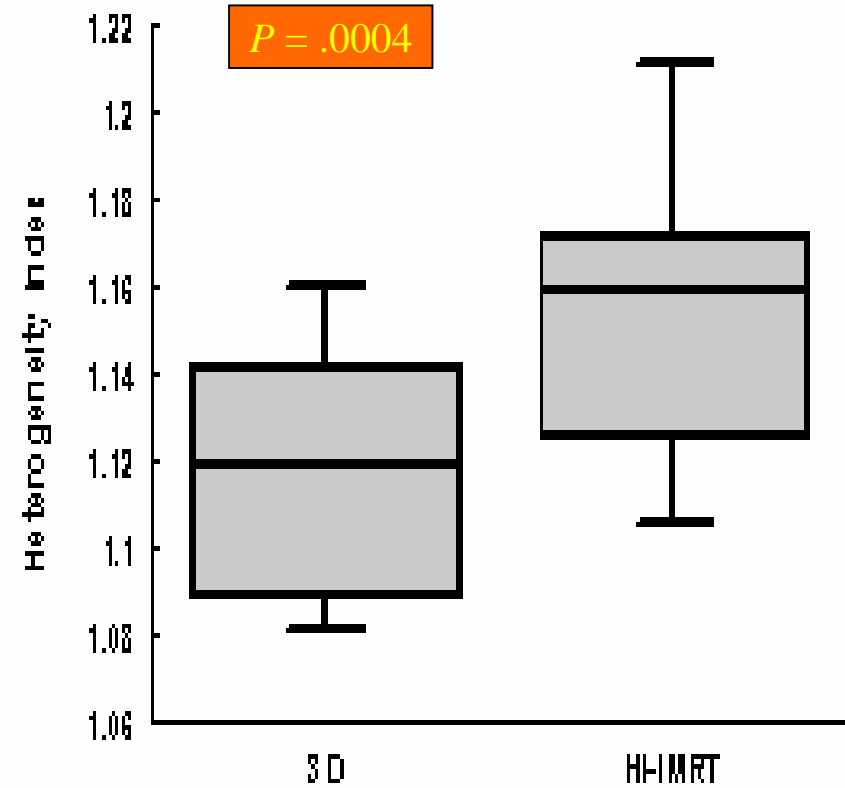
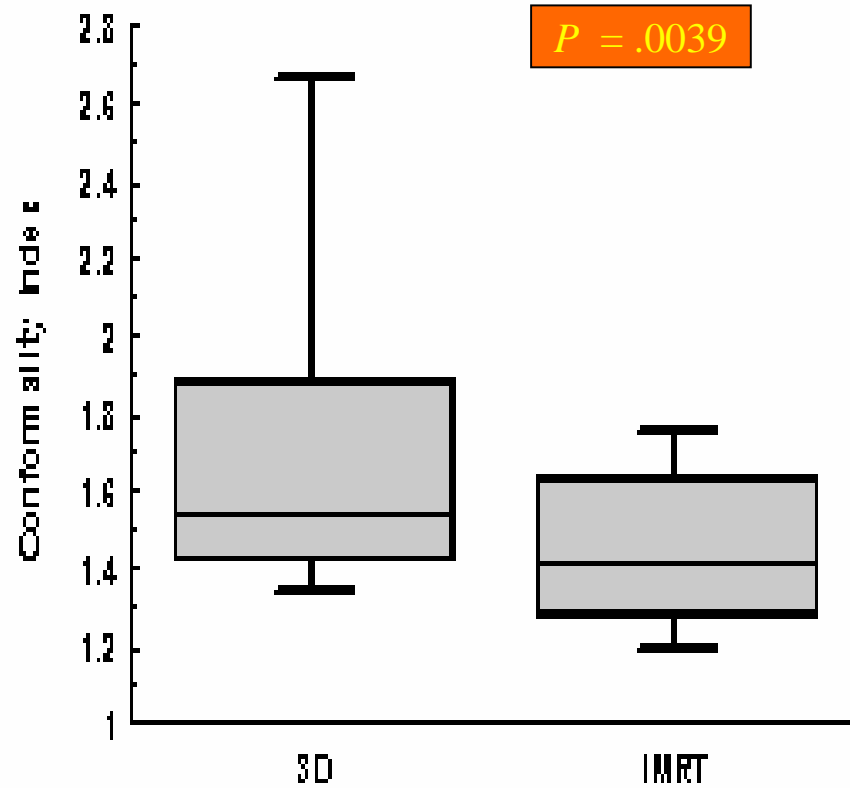
- 3D/IMRT



# Results

Parameters	3D	IMRT	<i>p</i> 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

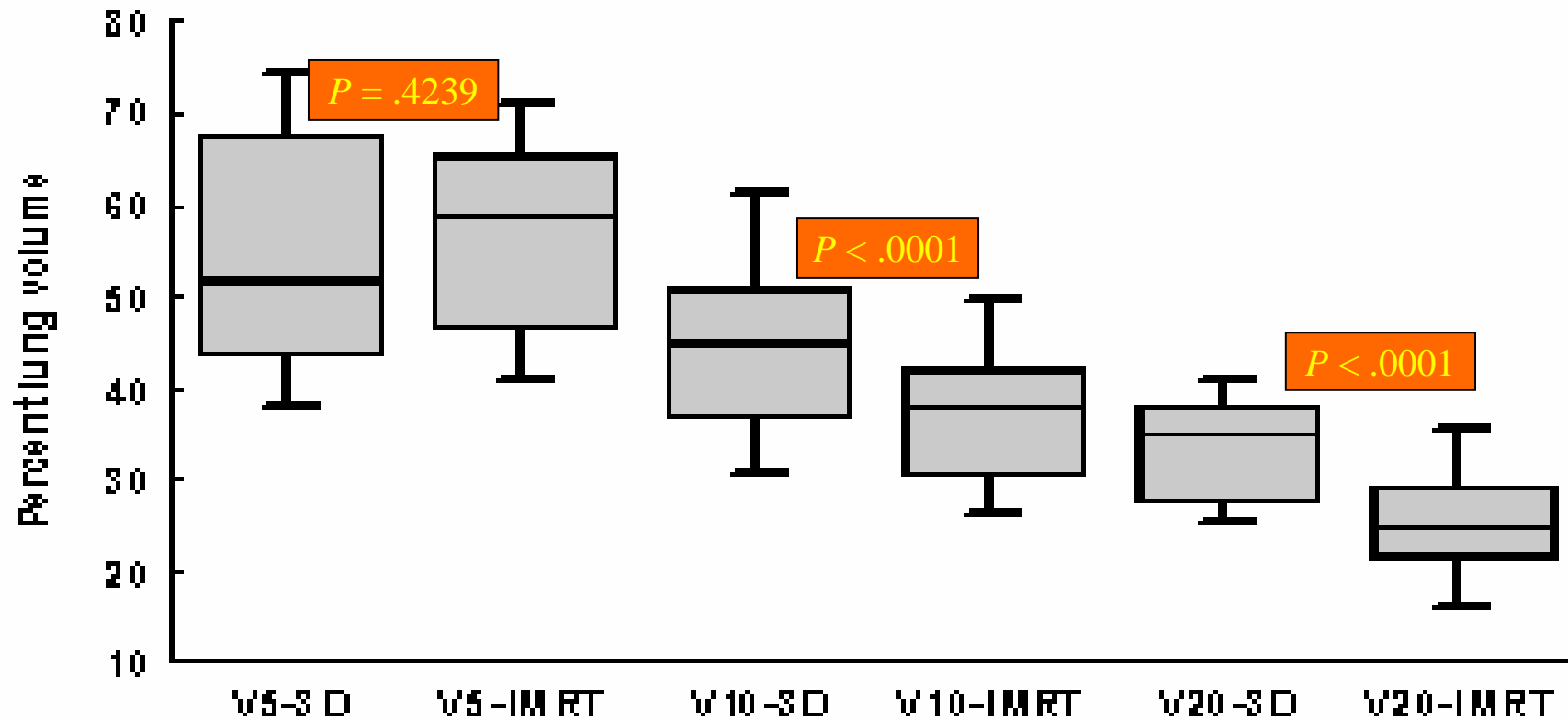
# Results



# Results

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

# Results



# Results

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- 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	<i>p</i> 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	<i>p</i> value
	Median (range)	Median (range)	
Thoracic Normal Tissue V5 (cc)	<b>5658</b> (3040.30-11596.00)	<b>6929</b> (2759.00-10788.00)	0.0064
Thoracic Normal Tissue V20 (cc)	<b>3919</b> (1919.00-6776.00)	<b>3398</b> (1509.00-6535.00)	0.0014
Thoracic Normal Tissue V40 (cc)	<b>3213</b> (1560.00-5489.00)	<b>2673</b> (1242.00-5402.00)	< 0.0001
Thoracic Normal Tissue Integral D	<b>180.46</b> (87.97-311.92)	<b>185.71</b> (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

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- 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

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- 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