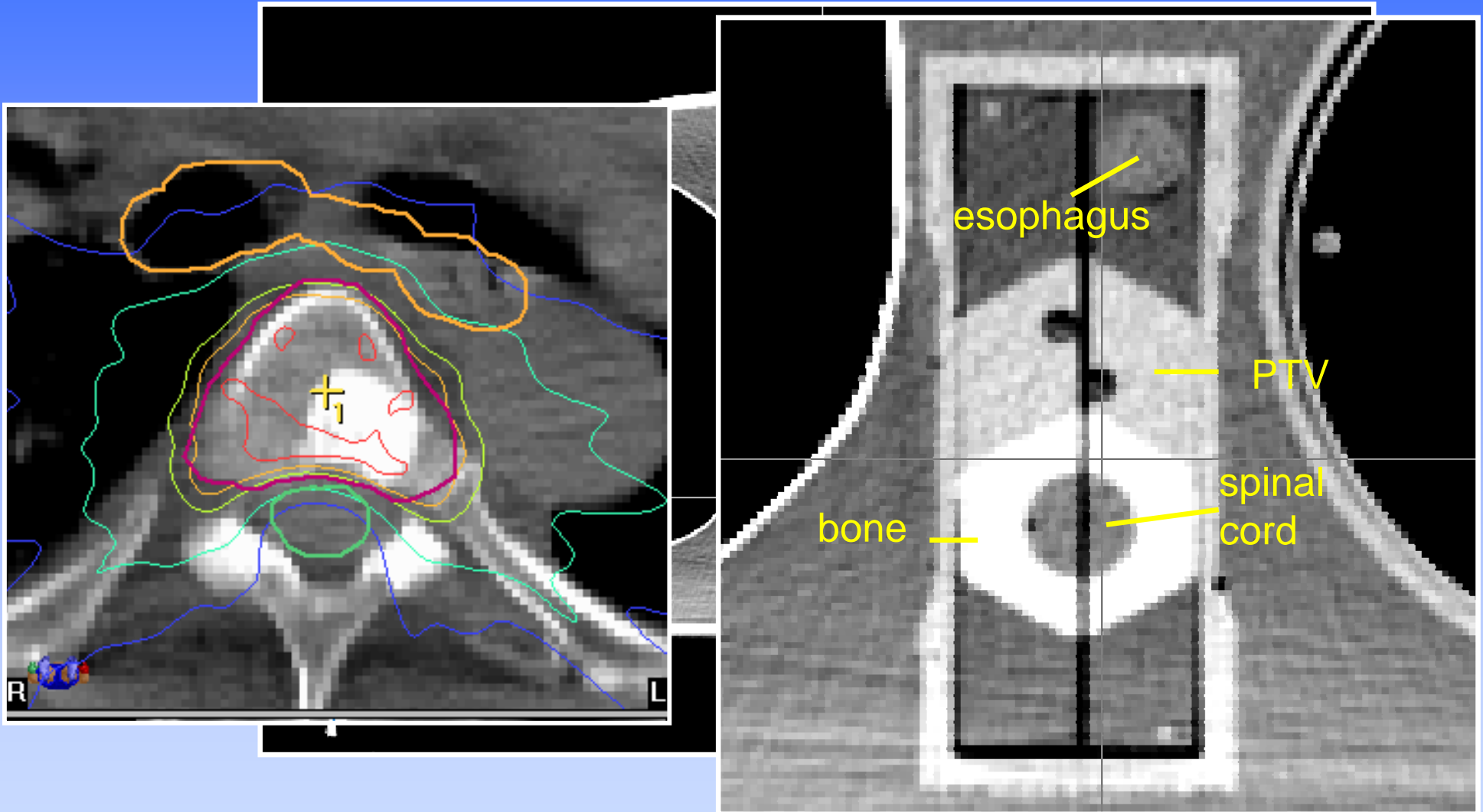# Initial Results from Multiple Irradiations of an Anthropomorphic Spine Phantom

Andrea Molineu, Nadia Hernandez, Paola Alvarez, David Followill, Geoffrey Ibbott

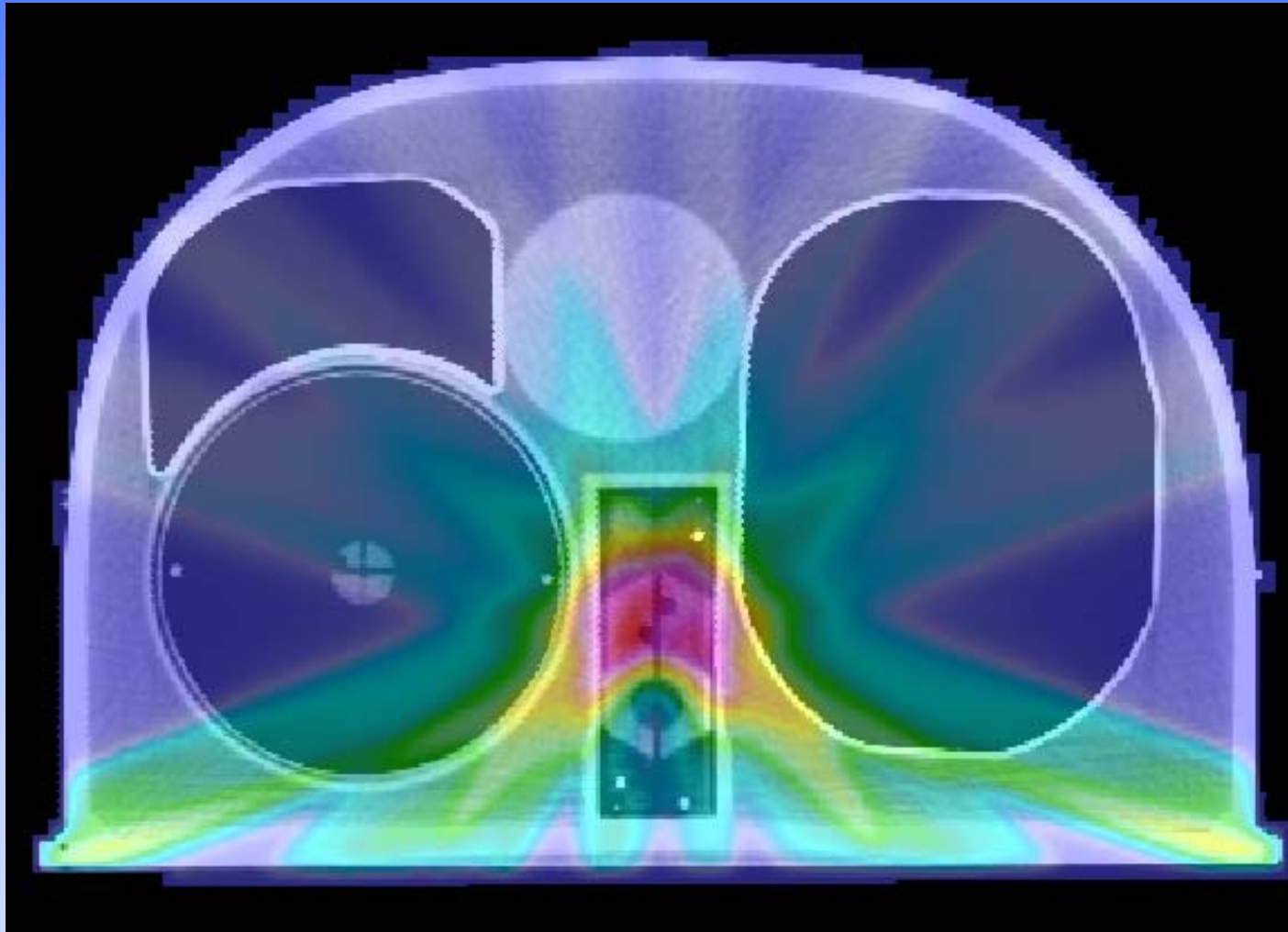Radiological Physics Center

Spine phantom

Treatment Plan

- 6 Gy to at least 90% of PTV

- Min PTV dose at least 5.25 Gy

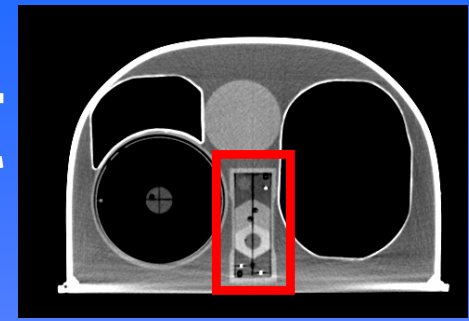| Normal structure	Volume	Volume Max (Gy)	Max Point Dose (Gy)
Spinal Cord	<0.35 cc <1.2 cc	3.75 2.63	5.25
Heart	<15 cc	6.00	8.25
Esophagus	<5 cc	4.46	6.00
Skin	<10 cc	8.63	9.75
Whole Lung	1000 cc	2.78	

Representative Treatment Plan

Criteria

- TLD
  ±7%

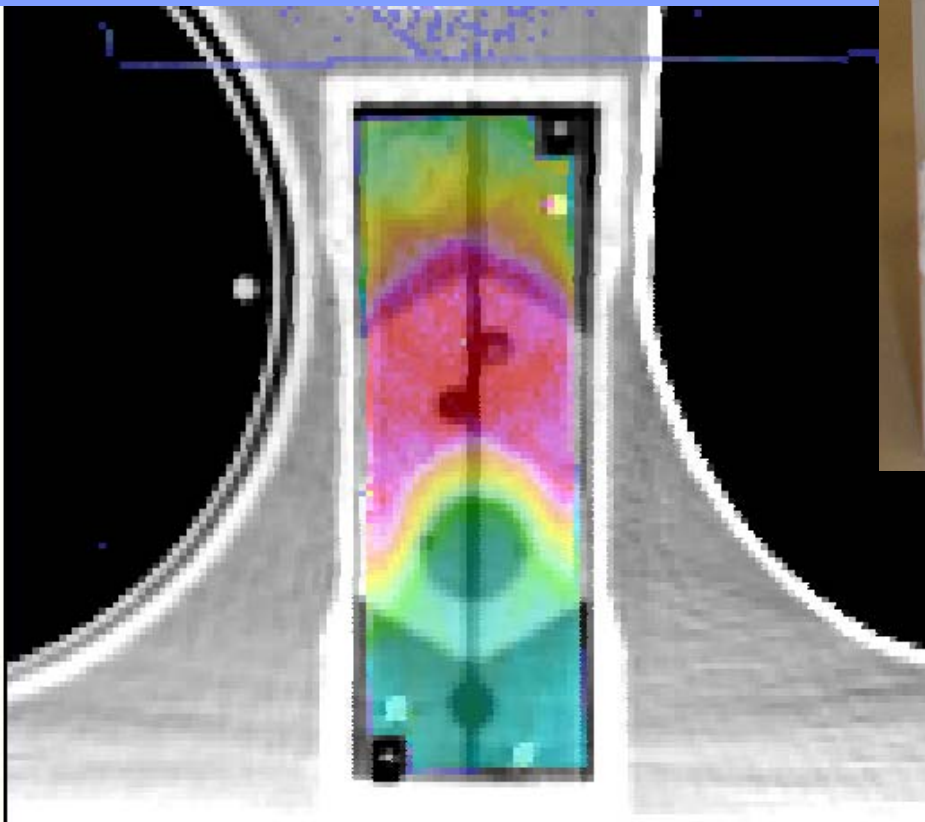- Film (axial and sagittal planes)
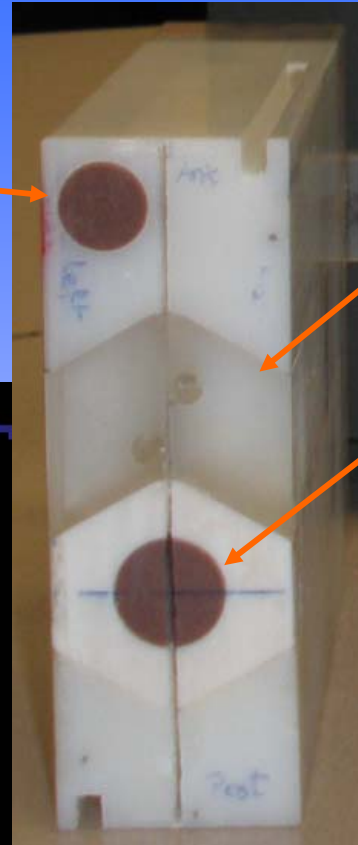 85% meet 5%/3mm

- Plan DVH
  must comply with protocol
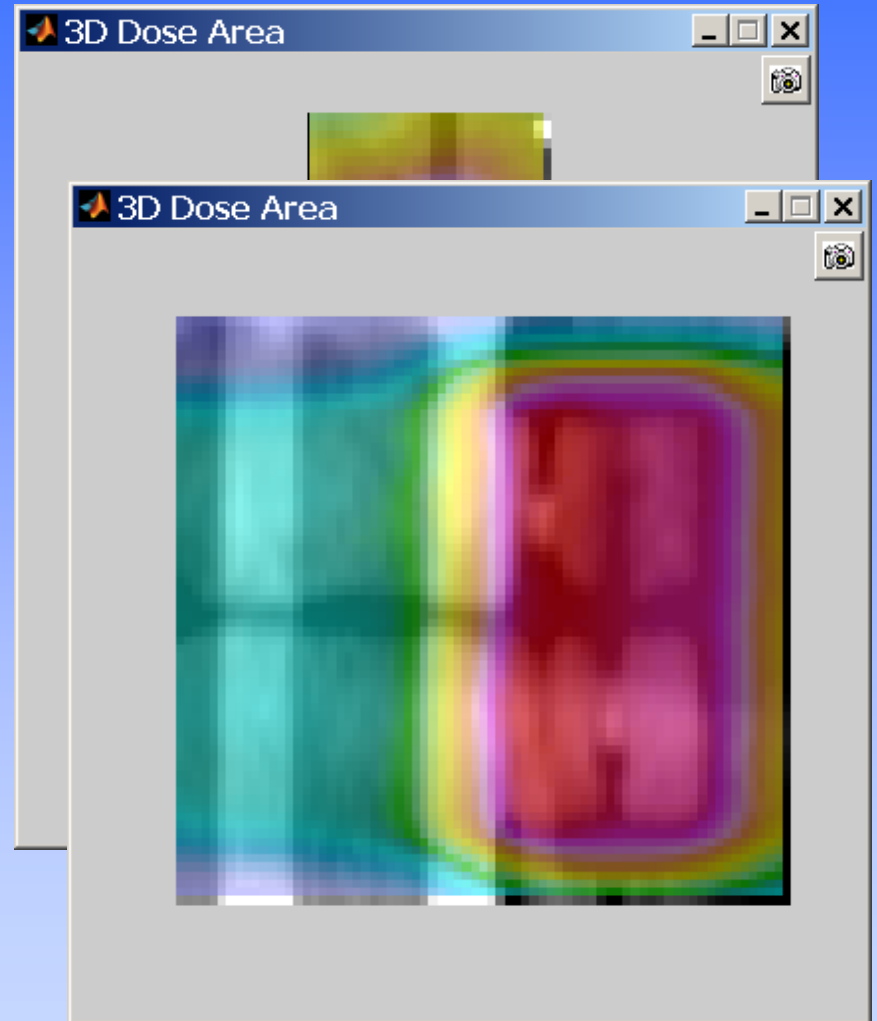
Good Agreement

OAR

PTV
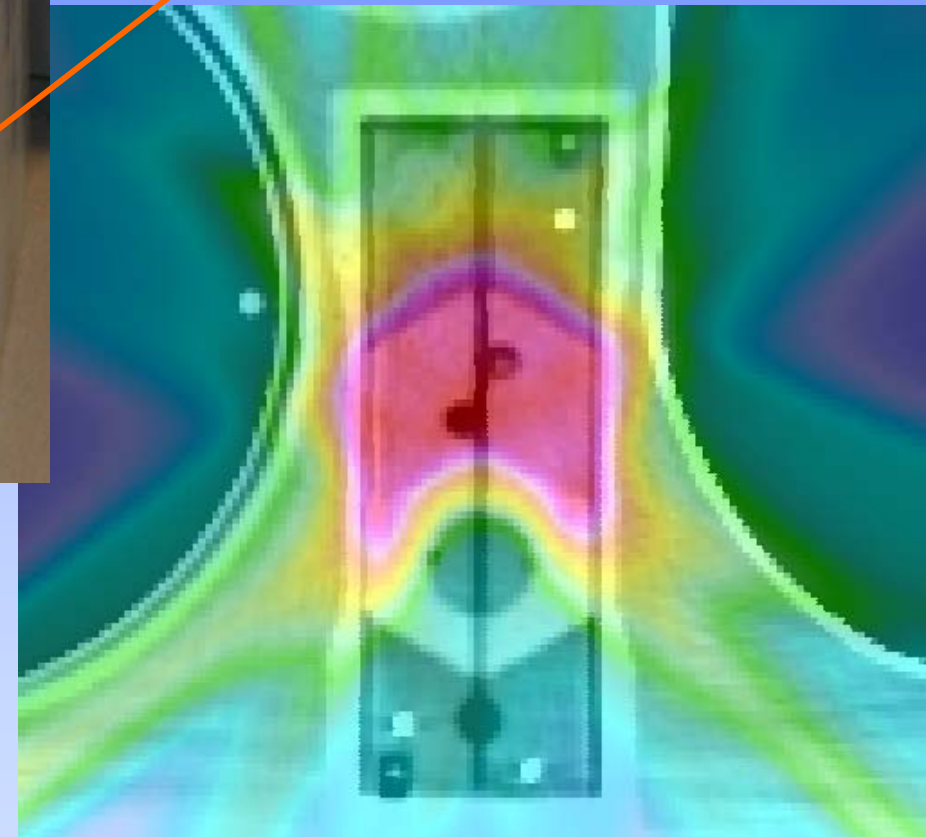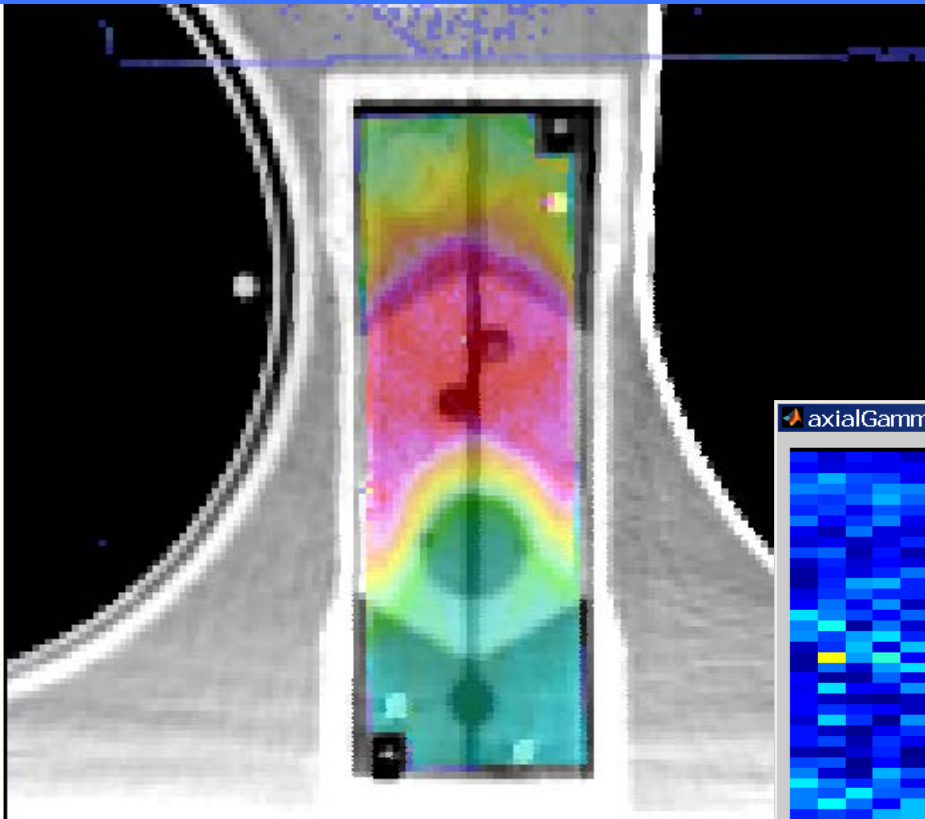
Cord/bone

Measurement

Plan

Good Agreement

Measurement

Gamma

100% passing
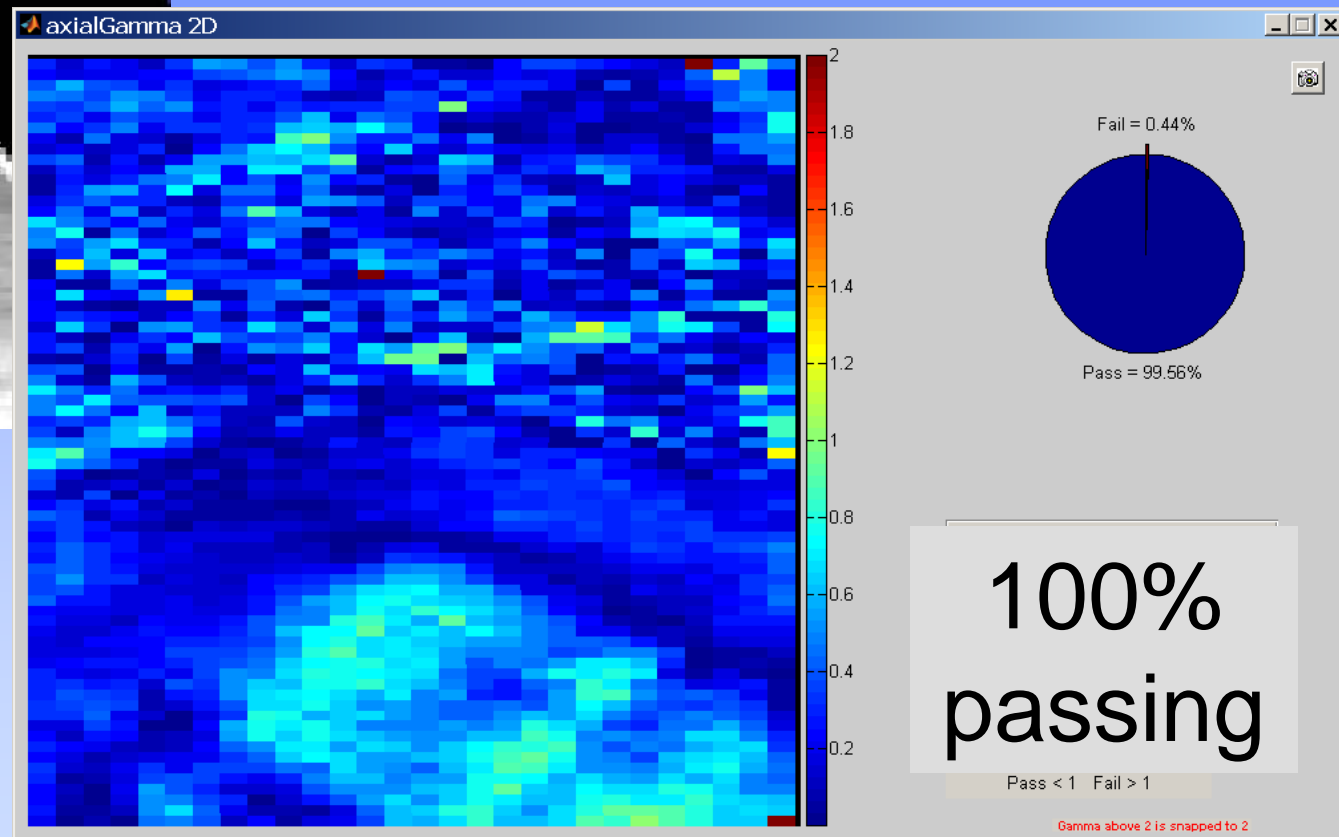
Poor Agreement

OAR

PTV
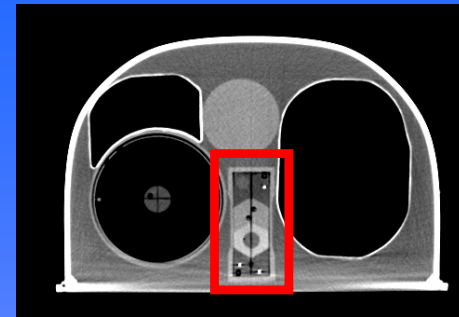
Cord/bone
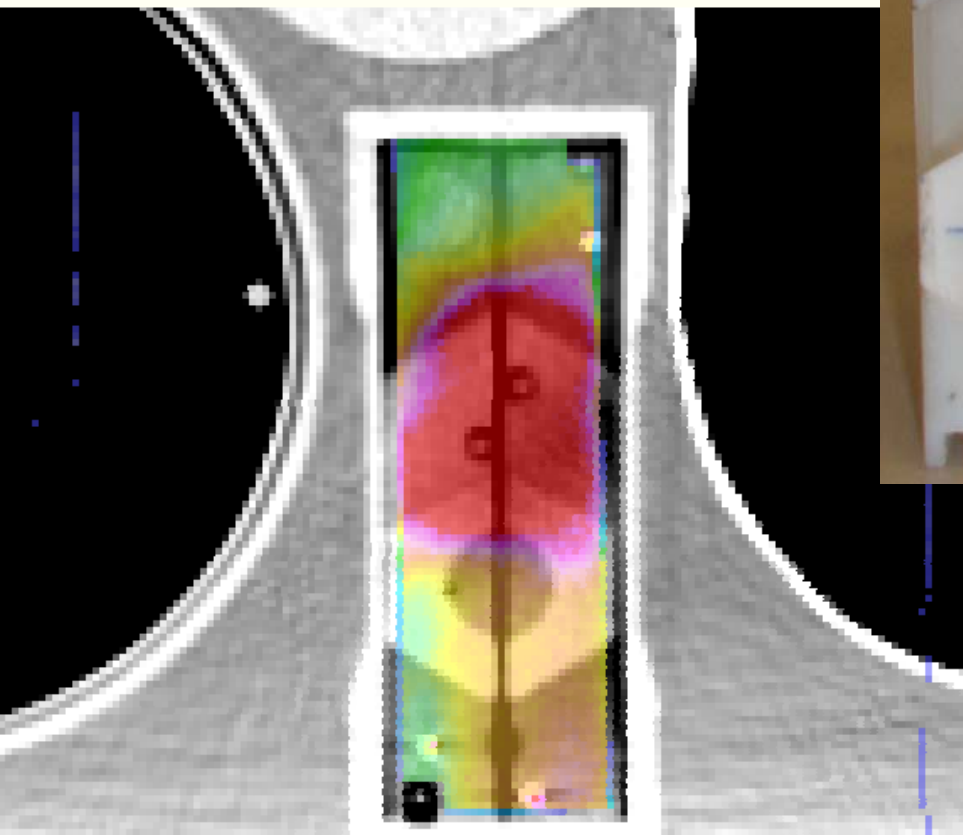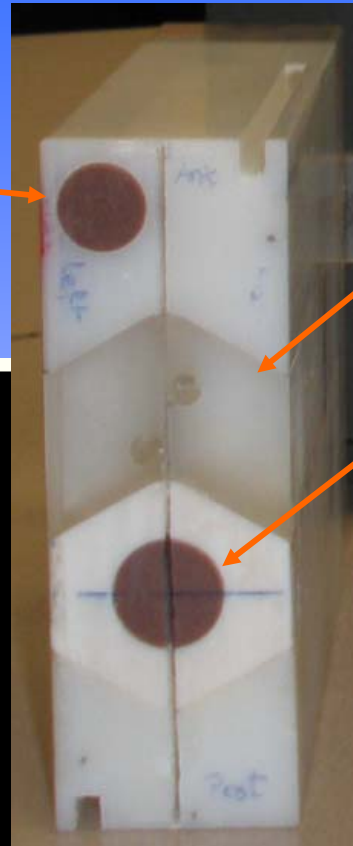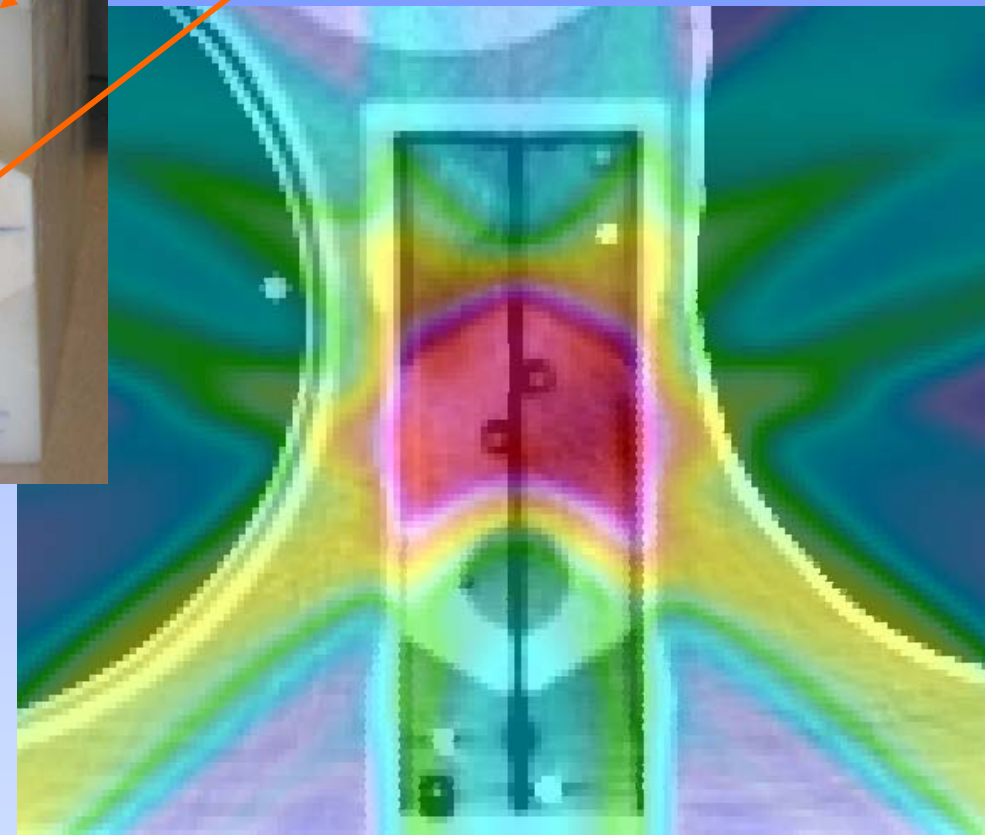
Measurement

Plan

Poor Agreement

Measurement

Gamma

Pass = 25.96%

Fail = 74.04%

26% passing

Pass < 1   Fail > 1

Gamma above 2 is snapped to 2
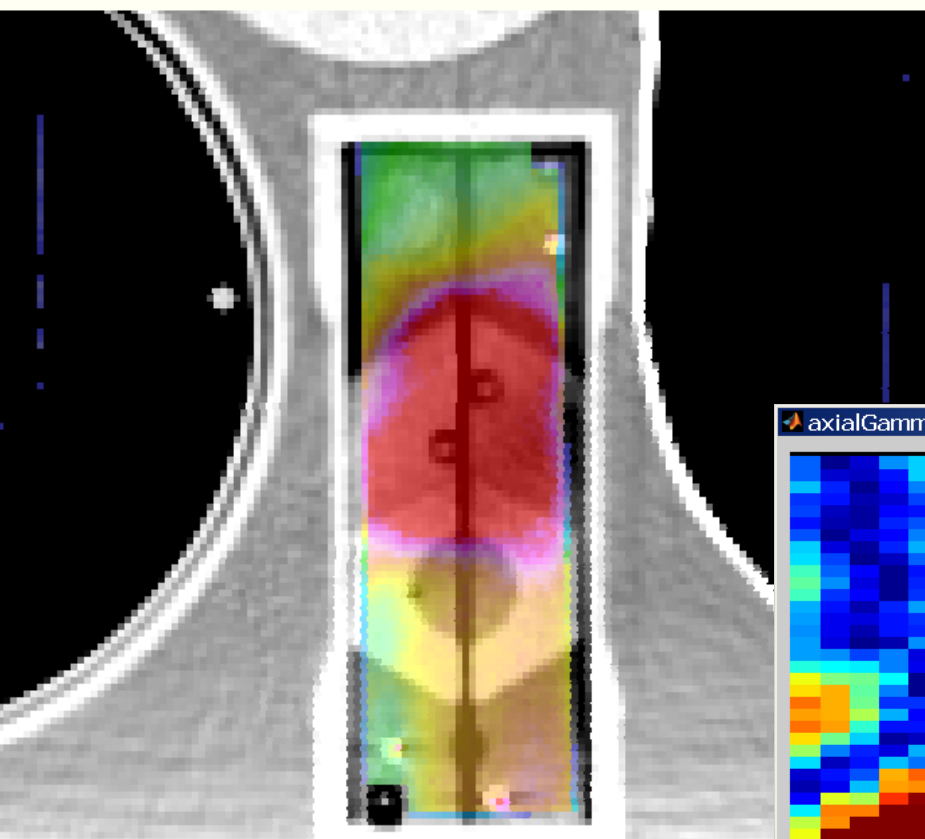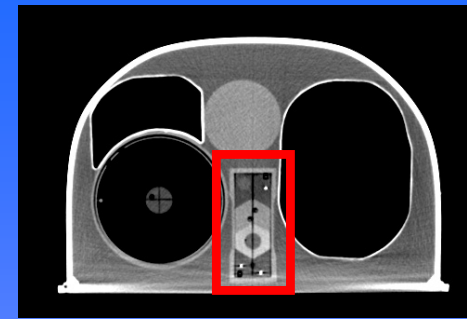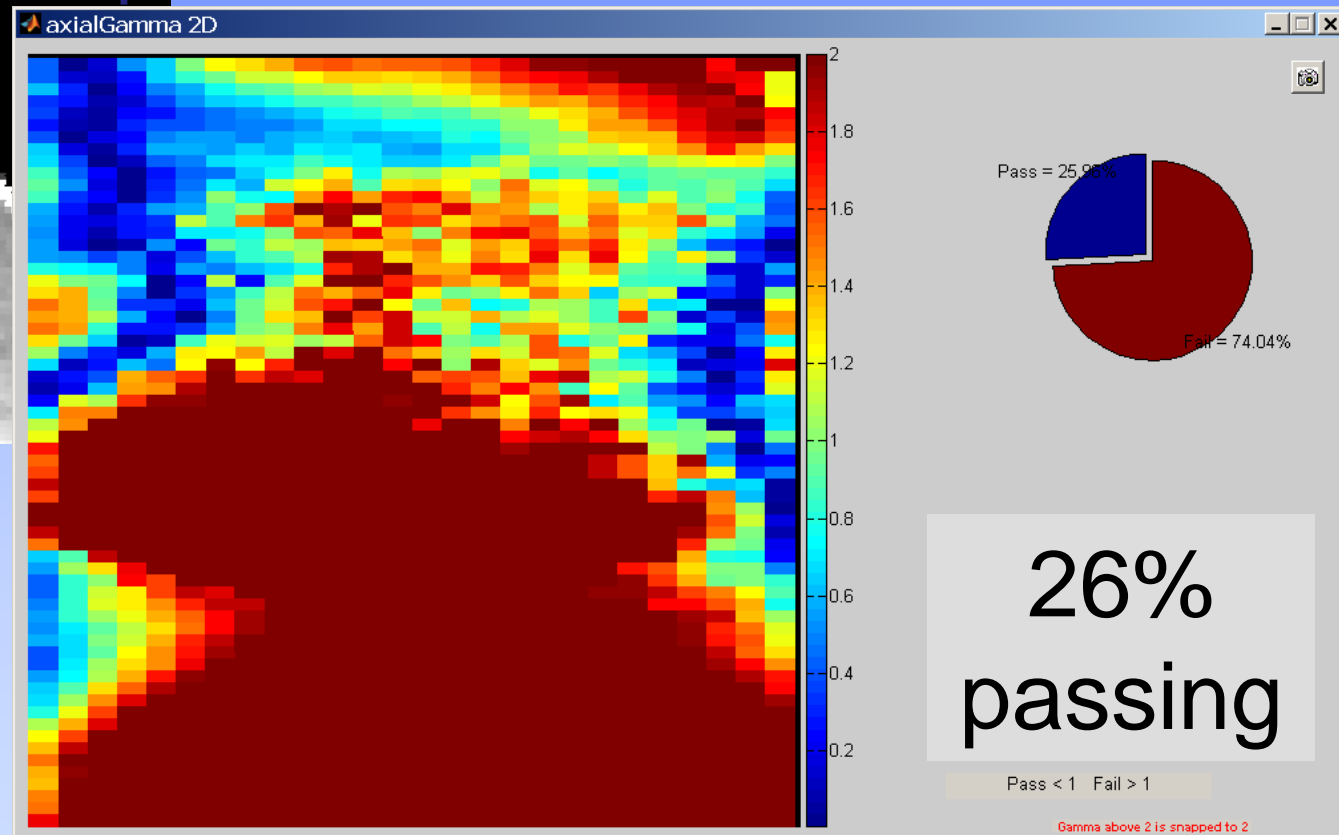
Overall results

- 41 irradiations at 35 institutions

- 17 irradiations failed

- 1 failed TLD criteria only

- 8 failed gamma criteria only

- 8 failed both TLD and gamma

All Results

	PTV	Heart	Axial Gamma	Sagittal Gamma
mean	0.99	1.02	85	86
std dev	0.05	0.17	16.4	14.6
range	0.88 - 1.15	0.67 - 1.51	22 - 100	42 - 99

Passing Results

	PTV	Heart	Axial Gamma	Sagittal Gamma
mean	0.99	1.02	94	94
std dev	0.03	0.12	4.6	5.1
range	0.93 - 1.03	0.67 - 1.18	85 - 100	85 - 99

Results by Machine

Machine Manufacturer	Irradiations	Passes	TLD Dose	Criteria Failed	
				Gamma	Dose and Gamma
CyberKnife	5	2	1	0	2
Elekta	6	2	0	2	2
Novalis	13	10	0	1	2
Siemens	2	1	0	1	0
TomoTherapy	2	1	0	1	0
Varian	13	8	0	3	2
total	41	24	1	8	8

Results by TPS

TPS	Algorithm	Irradiations	Passes	Criteria Failed		
				TLD Dose	Gamma	Dose and Gamma
CyberKnife	Monte Carlo	1	1	0	0	0
	raytracing	4	1	1	0	2
Eclipse	AAA	12	7	0	4	1
	pencil beam	2	1	0	0	1
Hi-Art	superposition	2	1	0	1	0
iPlan	Monte Carlo	4	2	0	1	1
	pencil beam	8	7	0	0	1
Pinnacle	convolution	5	3	0	1	1
XiO	superposition	3	1	0	1	1
total		41	24	1	8	8

Results by Algorithm

Algorithm	Irradiations	Passes	Criteria Failed		
			Dose	Gamma	Dose and Gamma
AAA	12	7	0	4	1
superposition/ convolution	10	5	0	3	2
Monte Carlo	5	3	0	1	1
pencil beam	10	8	0	0	2
raytracing	4	1	1	0	2
total	41	24	1	8	8

Conclusions

- Challenging credentialing process

- Treatment couch should be considered in these treatments

- Cannot make generalizations with regard to machine, TPS, or algorithm

Thank you.

The investigation was supported by PHS grants CA10953 and CA81647 awarded by the NCI, DHHS.