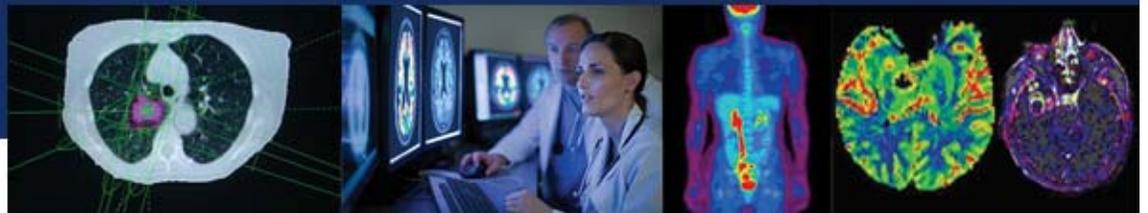


Results from multi-institutional measurements with an anthropomorphic spine phantom



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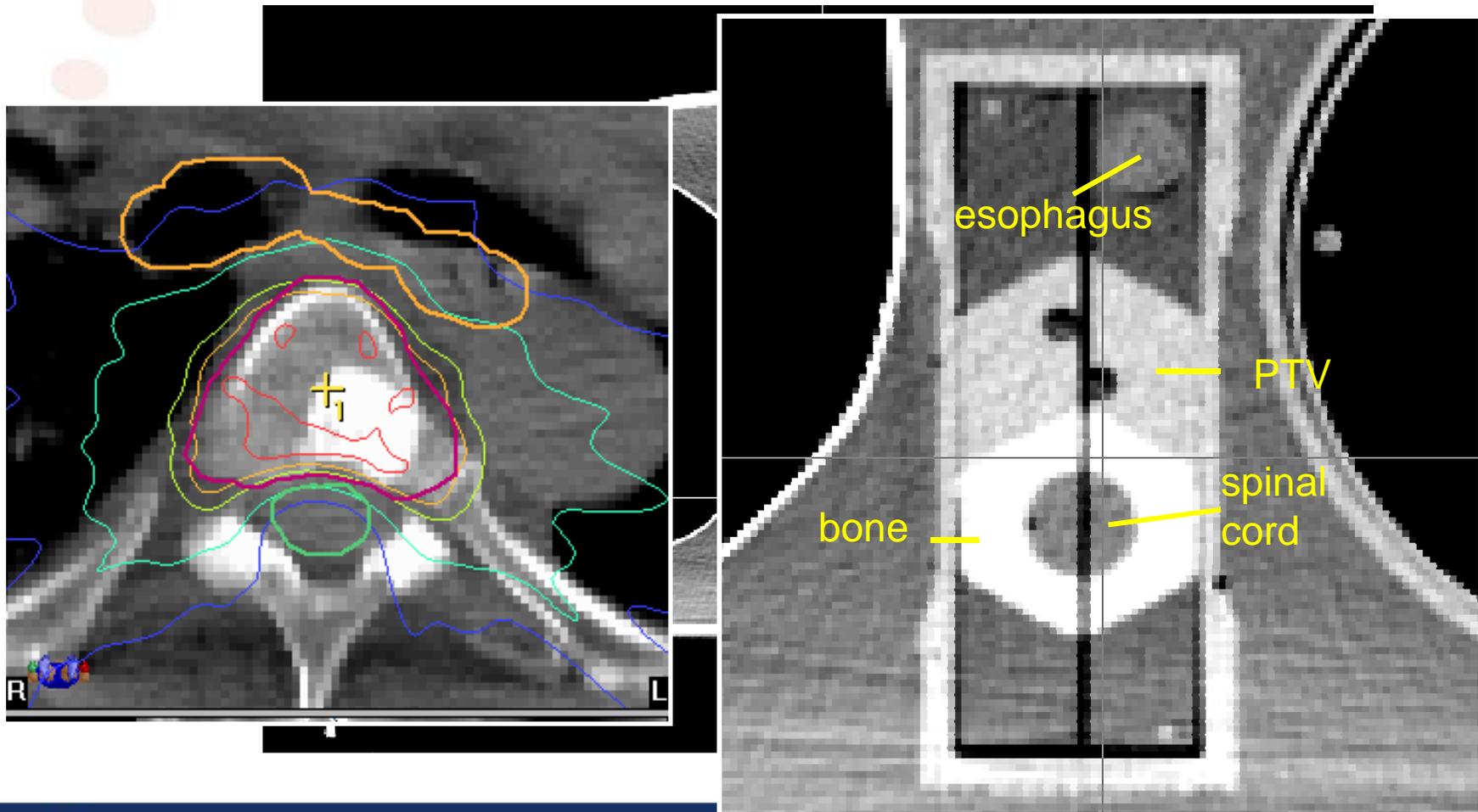
A Molineu, N Hernandez, P Alvarez, D Followill

AAPM

Anaheim, CA

July 2015

Spine phantom

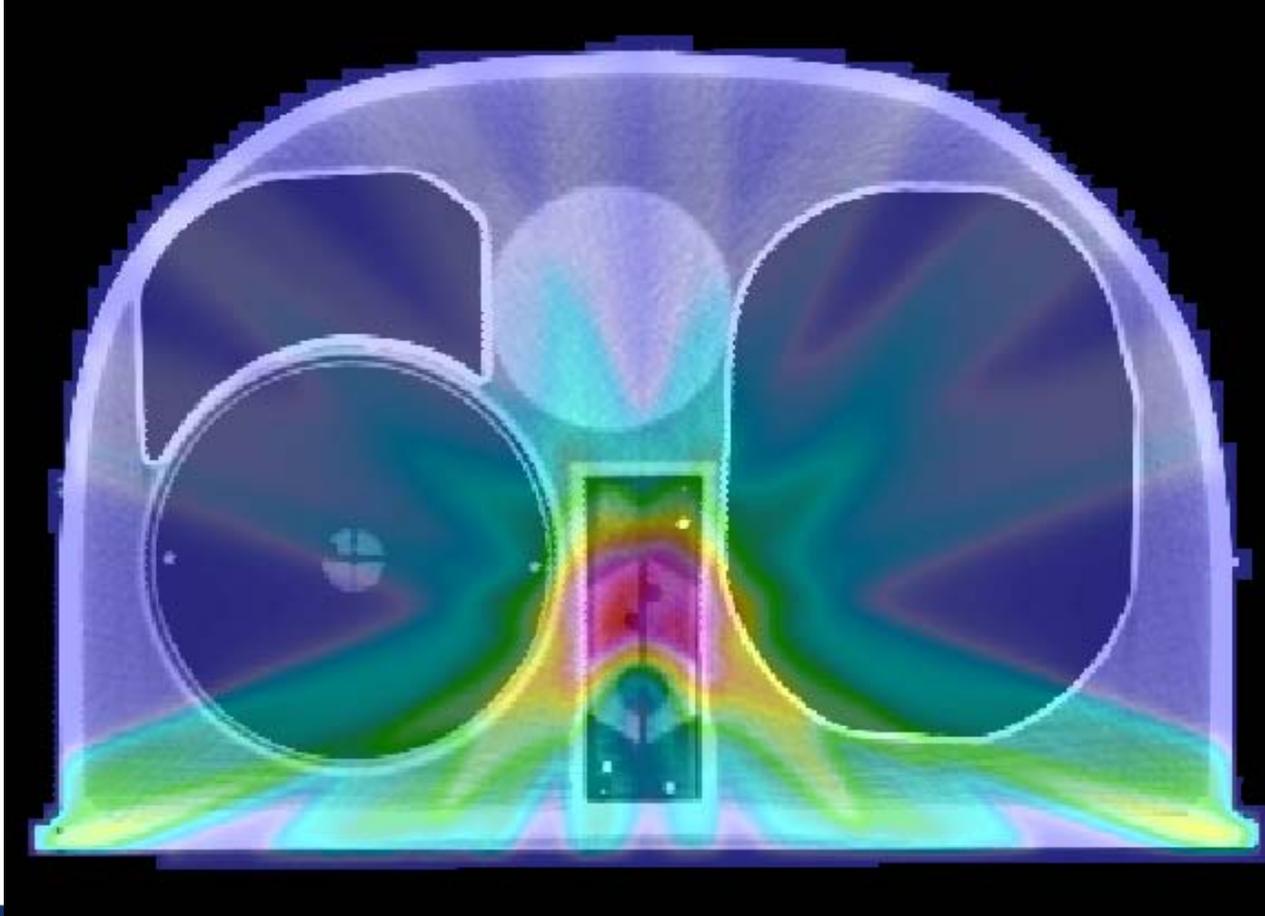


Treatment Plan

- 6 Gy to at least 90% of PTV
- Min PTV dose at least 5.25 Gy

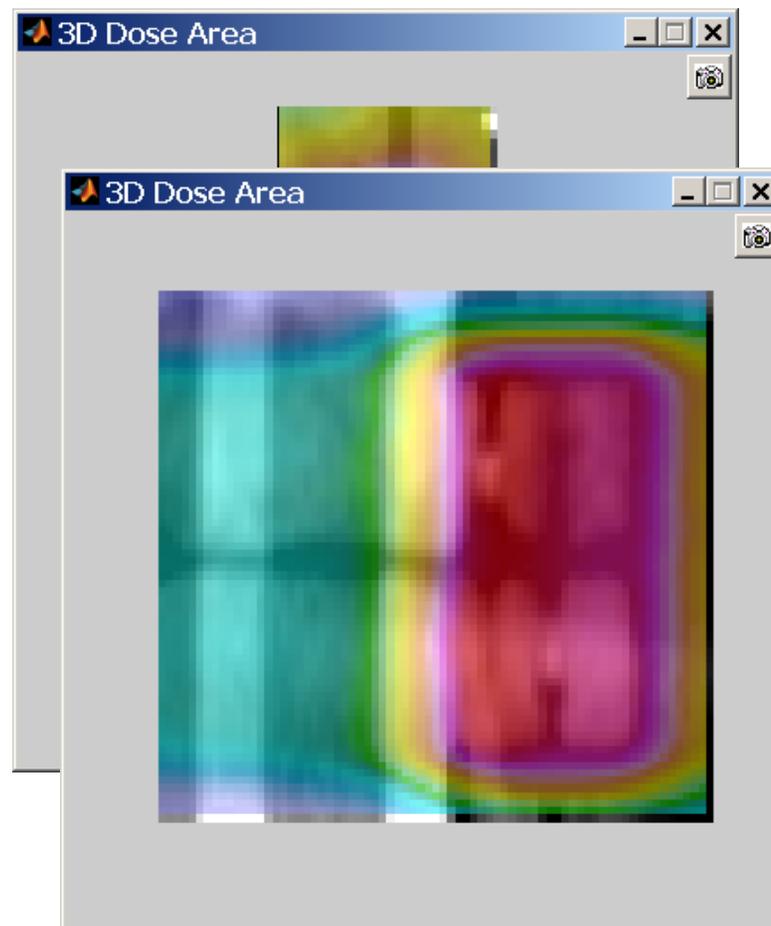
Normal structure	Volume	Volume Max (Gy)	Max Point Dose (Gy)
Spinal Cord	<0.35 cc <1.2 cc	3.75 2.63	5.25
Heart	<15 cc	6.00	8.25
Esophagus	<5 cc	4.46	6.00
Skin	<10 cc	8.63	9.75
Whole Lung	1000 cc	2.78	

Representative Treatment Plan

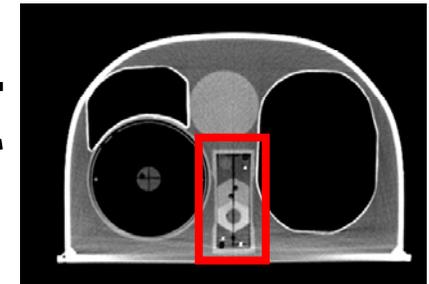


Criteria

- TLD
±7%
- Film (axial and sagittal planes)
85% meet 5%/3mm
- Plan DVH
must comply with protocol



Good Agreement

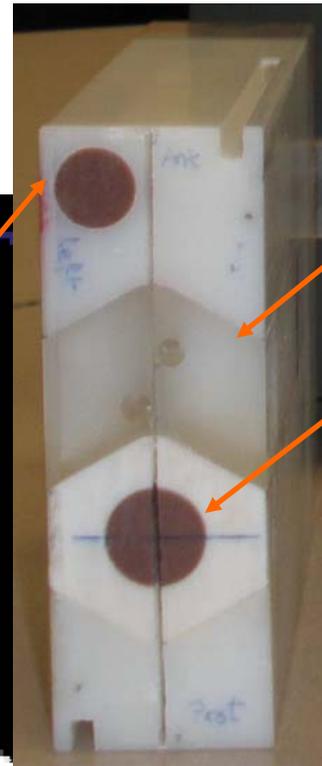


Plan

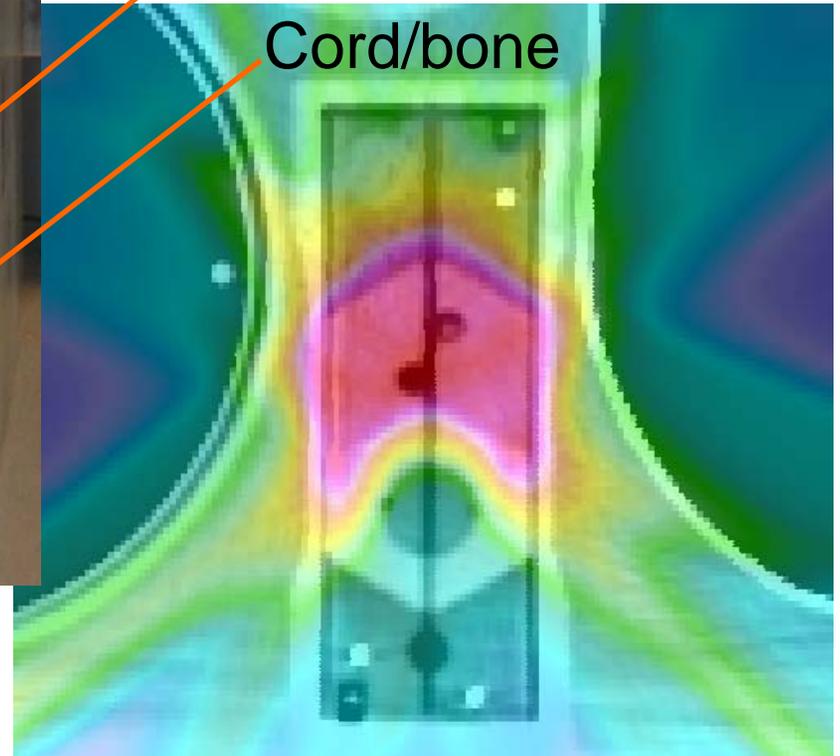
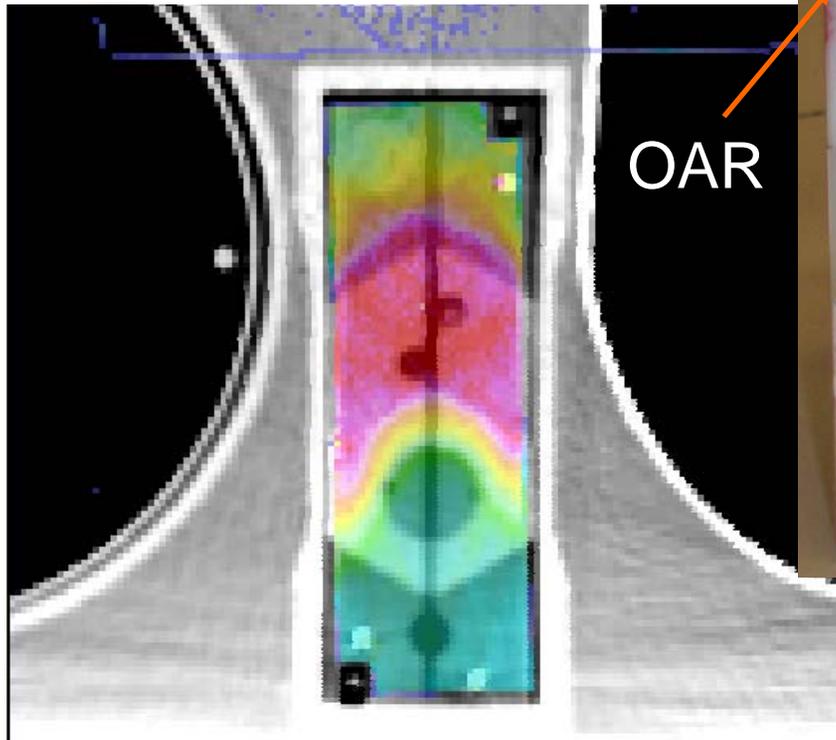
PTV

Cord/bone

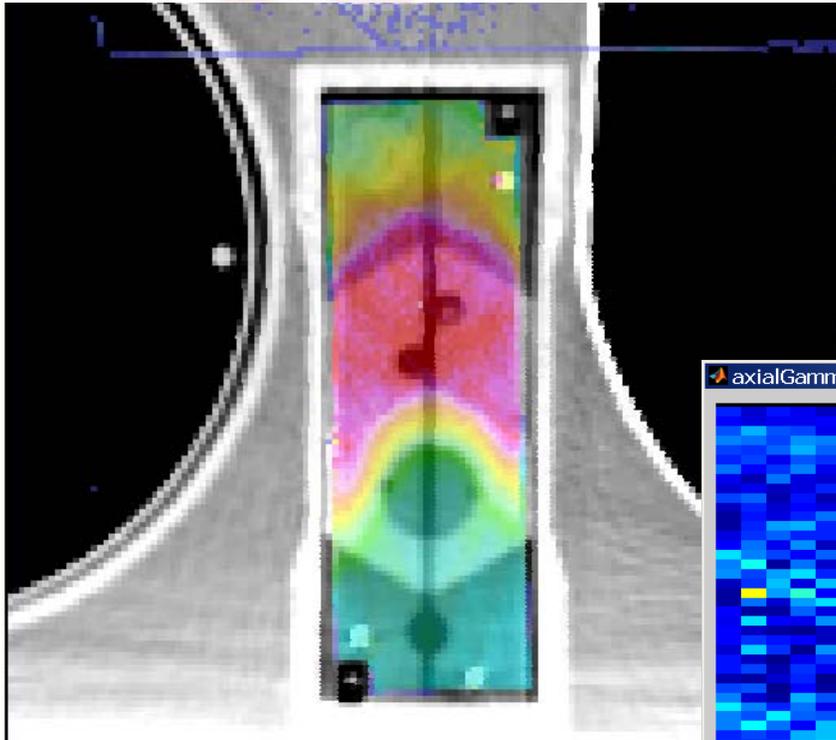
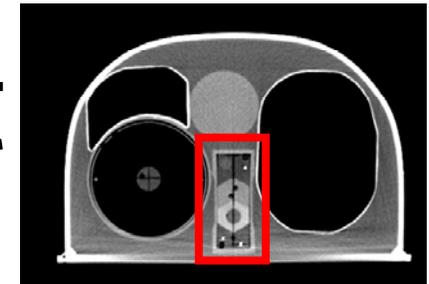
Measurement



OAR

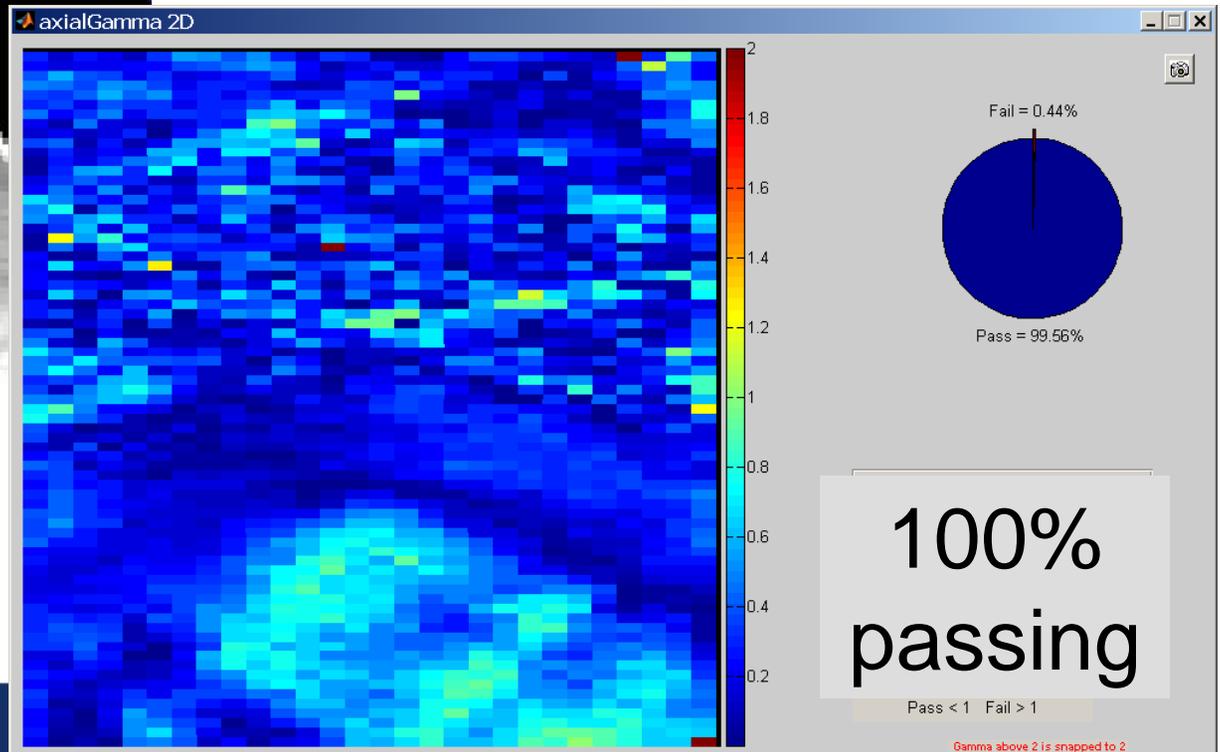


Good Agreement

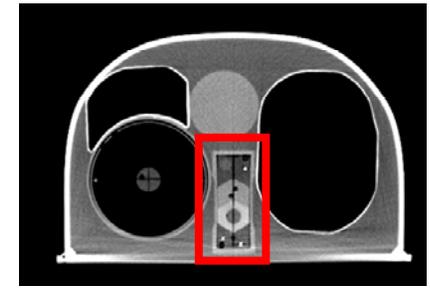


Measurement

Gamma

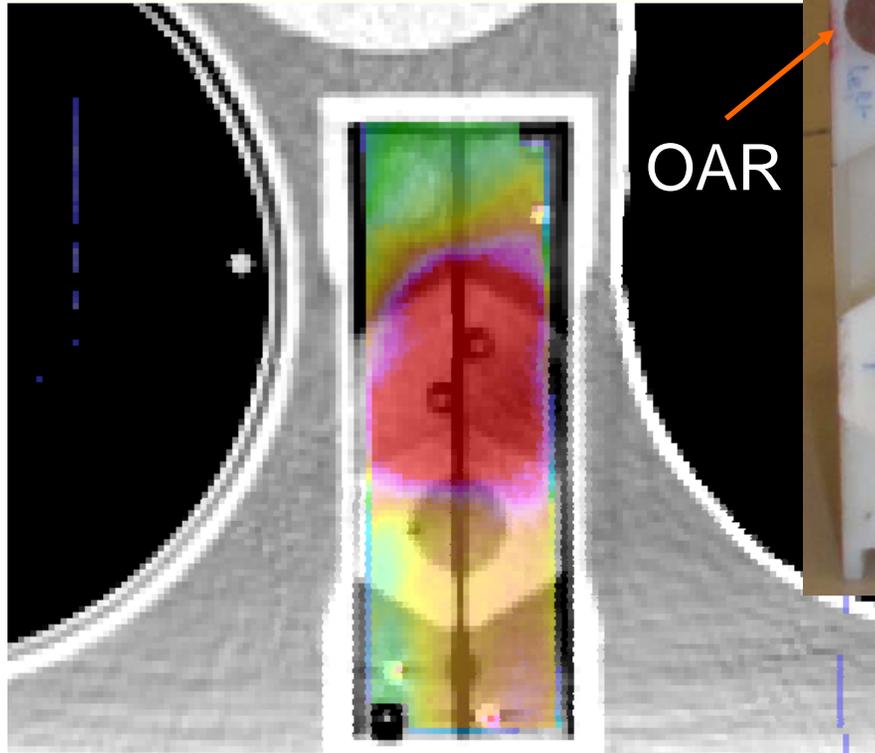


Poor Agreement

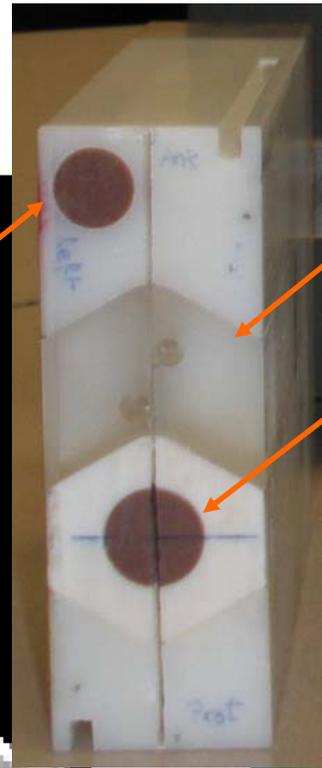


Plan

Measurement

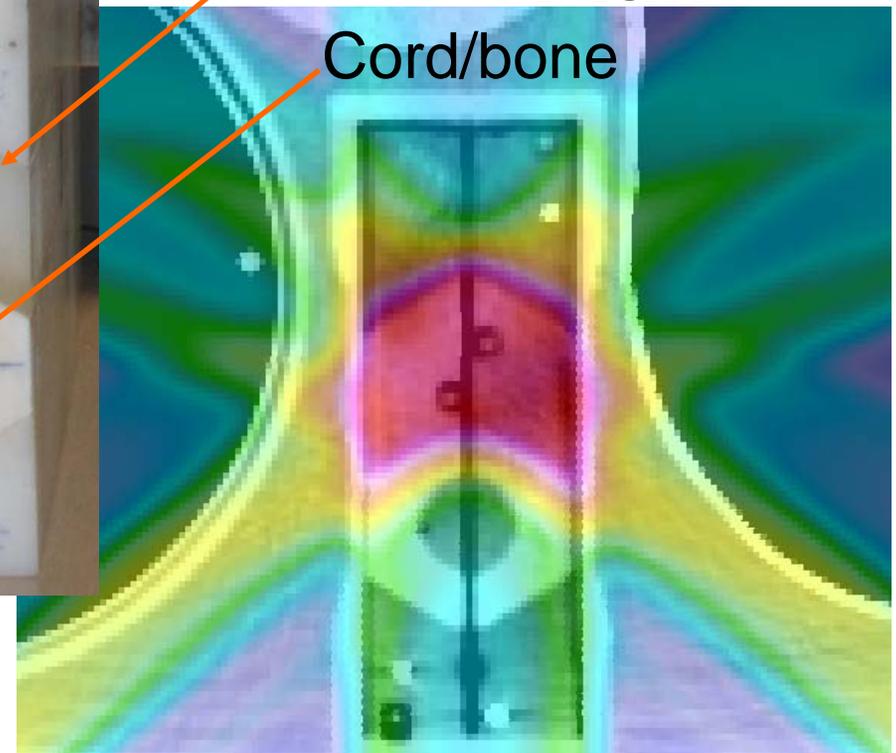


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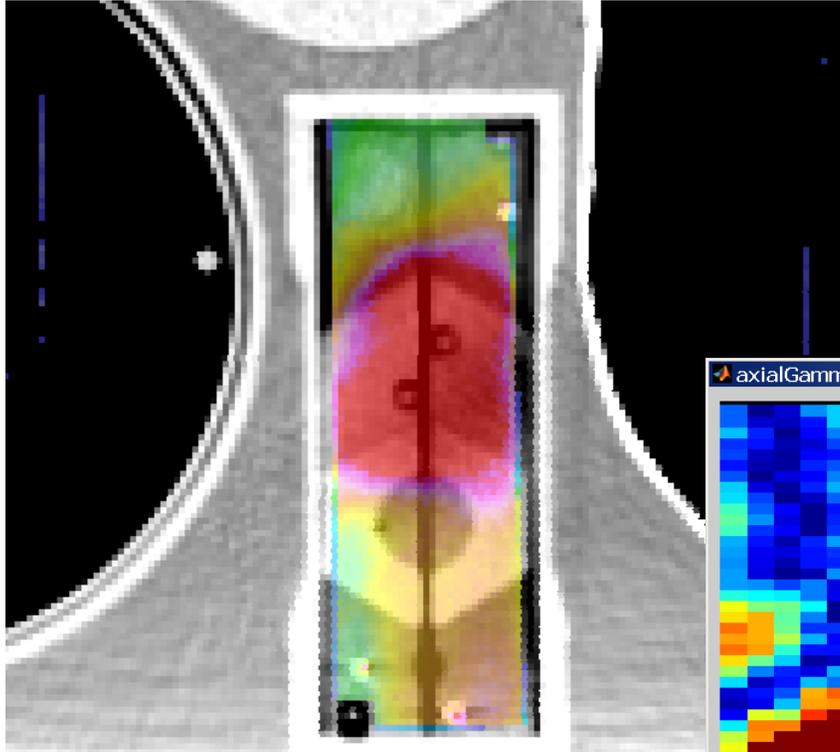
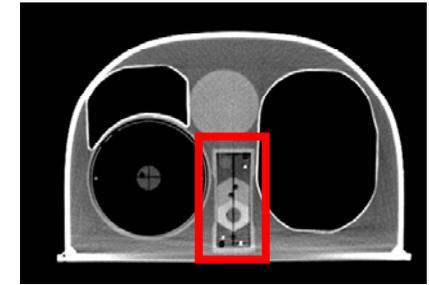


PTV

Cord/bone

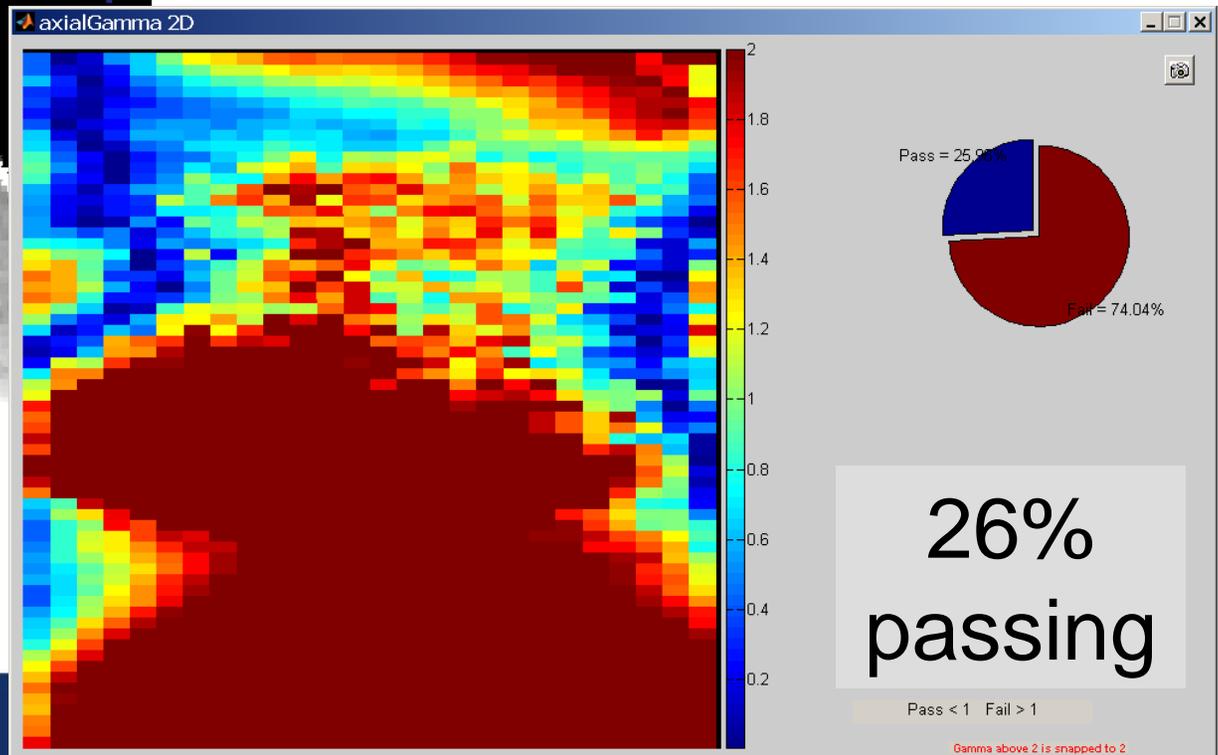


Poor Agreement



Measurement

Gamma



Overall results

- 274 irradiations at 191 institutions
- 68 irradiations failed (75% pass rate)
- 2 failed TLD criteria only
- 43 failed gamma criteria only
- 23 failed both TLD and gamma

Spine Results

	PTV	Axial Gamma	Sagittal Gamma
mean	0.99	90	90
std dev	0.04	11.7	11.5
range	0.78 – 1.23	22 - 100	36 - 100

Results by Machine

Machine Manufacturer	Pass Rate (%)	Attempts	Criteria Failed		
			Dose	Gamma	Dose and Gamma
CyberKnife	71	38	1	6	4
Elekta	69	29	0	4	5
Novalis	79	29	0	3	3
Siemens	60	5	0	1	1
TomoTherapy	80	20	0	4	0
Varian	76	151	1	25	10
Vero	100	2	0	0	0
total		274	2	43	23

Results by TPS

TPS	Pass Rate (%)	Attempts	Criteria Failed		
			Dose	Gamma	Dose and Gamma
Cyberknife	71	38	1	6	4
Eclipse	78	126	0	21	7
Hi-Art	80	20	0	4	0
in-house	50	2	0	0	1
iPlan	75	20	0	3	2
Monaco	100	3	0	0	0
Pinnacle	73	56	1	7	7
RayStation	100	2	0	0	0
XiO	43	7	0	2	2
total		274	2	43	23

Results by Algorithm

Algorithm	Pass Rate (%)	Attempts	Criteria Failed		
			Dose	Gamma	Dose and Gamma
AAA	79	108	0	18	5
Acuros	77	13	0	2	1
adapt convolve/cc convolution	75	51	0	7	6
Monte Carlo	81	37	0	4	3
pencil beam	68	19	0	3	3
raytracing	50	12	1	3	2
superposition	71	34	1	6	3
total		274	2	43	23

Conclusions

- Challenging credentialing process
- Treatment couch should be considered in these treatments
- Cannot make generalizations with regard to machine, TPS, or algorithm

Conclusions

- Important QA tool
- Aids improvements to IMRT delivery
- All major linear accelerator and planning systems have ability to pass



Thank you!

The investigation was supported by PHS grants CA180803 and CA037422 awarded by the NCI, DHHS.



Thank You
Questions?