

Evaluation of 94 IMRT irradiations of an anthropomorphic H&N phantom

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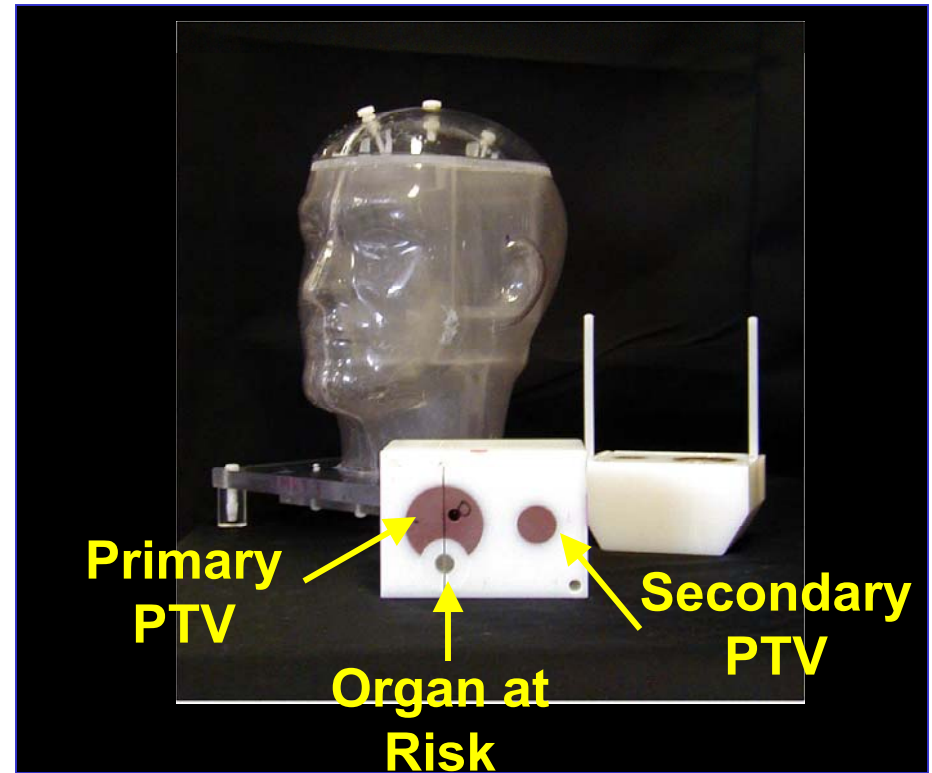


Advanced Technology Consortium (ATC)

- Phantom irradiation is required by many IMRT protocols
- RPC has developed and analyzes phantoms
- RPC uses ATC tools to review phantoms

IMRT H&N Phantom

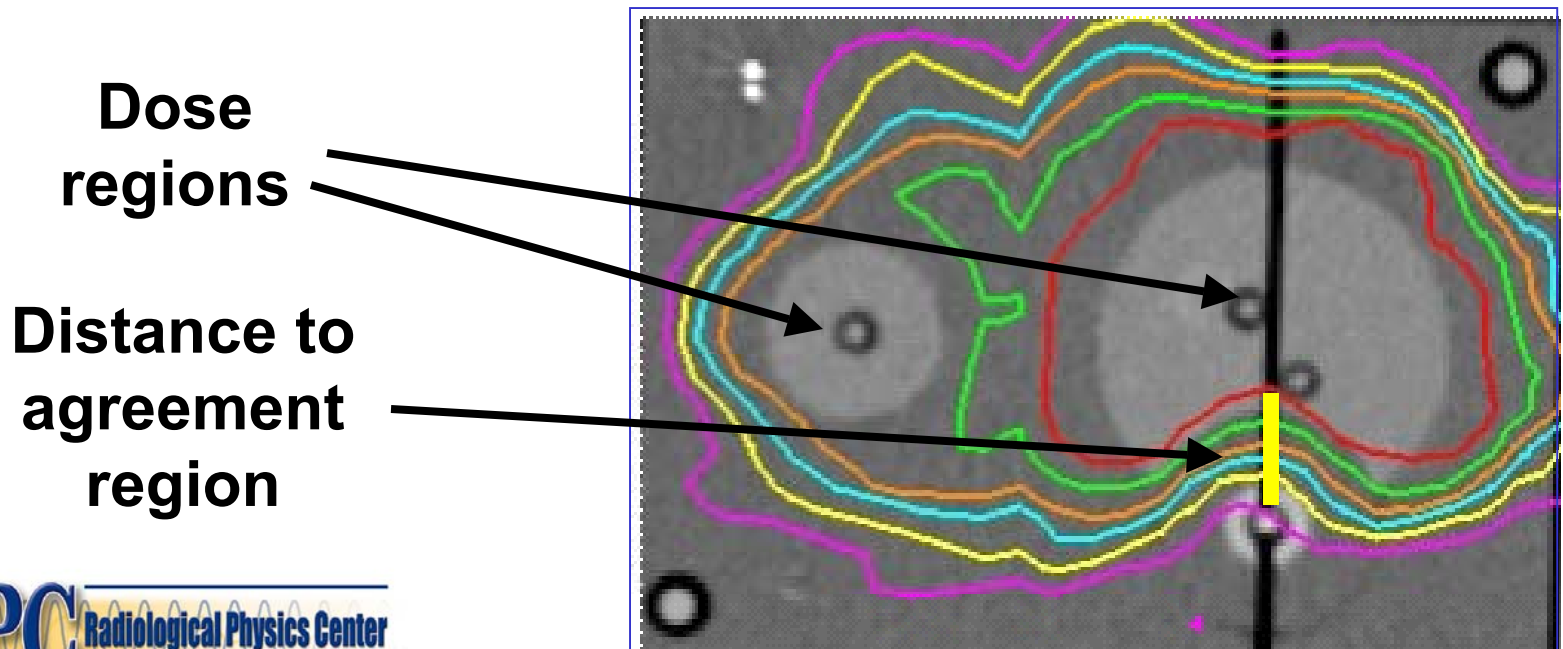
- **Primary PTV**
4 cm diameter
4 TLD
- **Secondary PTV**
2 cm diameter
2 TLD
- **Organ at risk**
1 cm diameter
2 TLD
- **Axial and sagittal**
radiochromic film



- **1° PTV treated to 6.6 Gy**
- **2° PTV treated to 5.4 Gy**
- **OAR limited to < 4.5 Gy**

Criteria for credentialing

- RPC/Inst dose in PTVs: 0.93-1.07
- distance to agreement in high gradient region near OAR: ≤ 4 mm



IMRT H&N Phantom Results

- 94 irradiations were analyzed
- 62 irradiations passed the criteria
 - 16 institutions irradiated multiple times
- 32 irradiations did not pass the criteria
- 74 institutions are represented

Only 62% of institutions passed the criteria on the first irradiation.

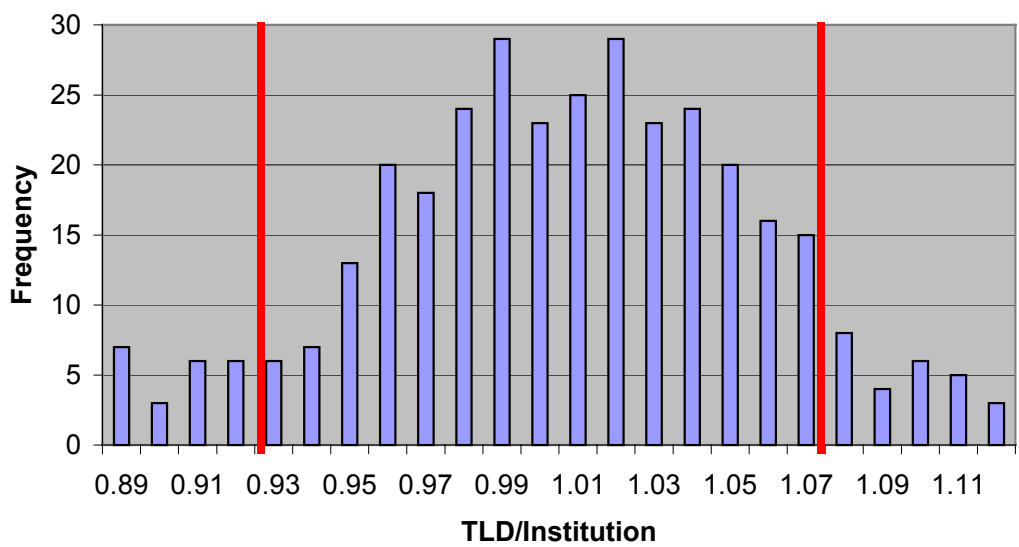
IMRT H&N Phantom Results cont.

- 18 failed by TLD results only
- 5 failed by film results only
- 9 failed by both

	1° PTV	2° PTV	OAR	Displ. (mm)
mean	1.01	1.00	1.09	-1.2
std dev	0.054	0.050	0.27	3.5
count	227	113	113	94
range	0.78-1.13	0.85-1.22	0.42-2.24	-15 thru 8

IMRT H&N Phantom Results cont.

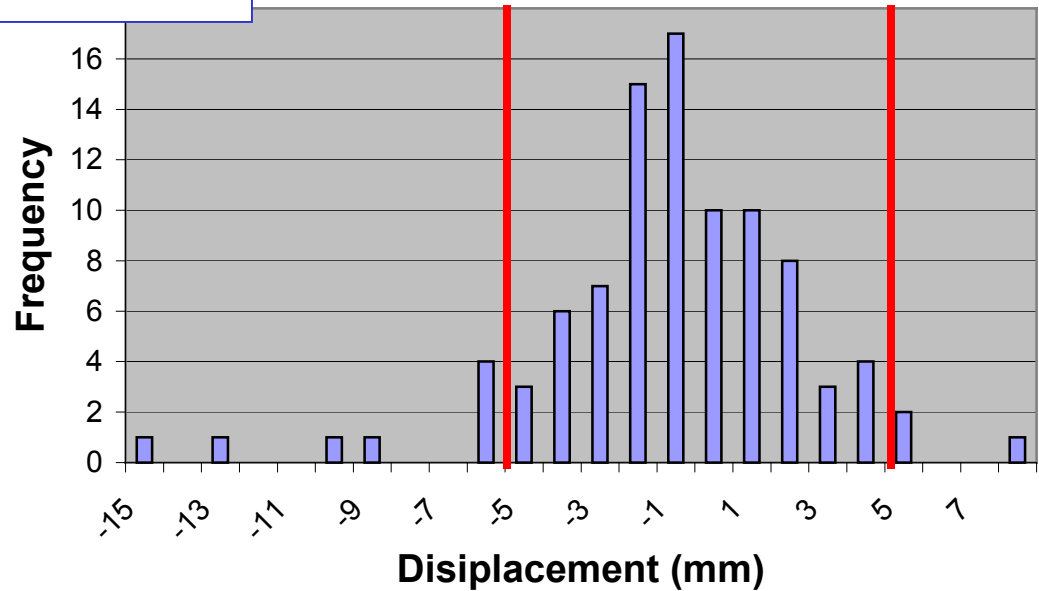
TLD/Inst Ratio for all PTV



← PTV TLD results

Dose profile →
displacement

Displacement



Results grouped by accelerator manufacturer

Linear Accelerator Manufacturer	Fails	Attempts	Criteria Failed		
			TLD only	Film only	TLD and Film
BrainLab	0	1	0	0	0
Elekta	3	7	2	1	0
Siemens	5	17	3	0	2
TomoTherapy	1	2	1	0	0
Varian	23	67	12	4	7
total	32	94	18	5	9

Results grouped by treatment planning systems

Treatment planning system	Fails	Attempts	Criteria Failed		
			TLD only	Film only	TLD and Film
BrainScan	0	1	0	0	0
Cadplan	1	2	1	0	0
CMS XiO	1	6	0	0	1
Corvus	7	20	6	0	1
Eclipse	4	19	1	2	1
Helax	0	2	0	0	0
Pinnacle	15	36	8	3	4
Radionics XKnife	0	1	0	0	0
Theraplan Plus	2	2	0	0	2
TomoTherapy	1	2	1	0	0
Inst. developed TPS	1	3	1	0	0
total	32	94	18	5	9

Results grouped by IMRT technique

IMRT technique	Fails	Attempts	Criteria Failed		
			TLD only	Film only	TLD and Film
Dynamic MLC	4	19	2	1	1
IMAT	3	5	2	0	1
Segmental	23	67	12	4	7
TomoTherapy	1	2	1	0	0
total*	31	93	17	5	9

* This information was unavailable for 1 institution.

Results grouped by intensity modulation device

Intensity modulation device	Fails	Attempts	Criteria Failed		
			TLD only	Film only	TLD and Film
Binary	4	8	3	0	1
MLC	27	85	14	5	8
total*	31	93	17	5	9

* This information was unavailable for 1 institution.

Explanations for Failures

- **incorrect output factors in TPS**
- **incorrect PDD in TPS**
- **inadequacies in beam modeling at leaf ends (Cadman, et al; PMB 2002)**
- **not adjusting MU to account for dose differences measured with ion chamber**
- **setup errors**

Conclusions

- The phantom is valuable for evaluating IMRT for clinical trials
- QA of IMRT is important!



Photo courtesy of California Cancer Center

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