Adequacy of IMRT QA Procedures as Determined by Irradiations of a Head and Neck IMRT Anthropomorphic Phantom

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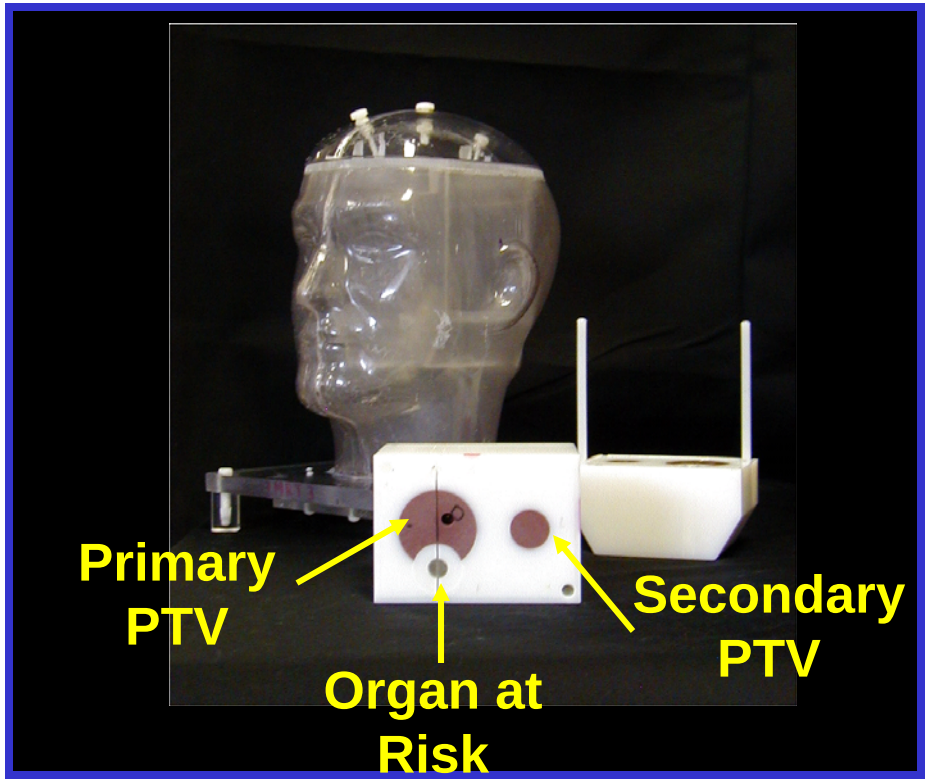
IMRT H&N Phantom

- **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 films**



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

Designed in collaboration with RTOG;
Molineu et al, IJROBP, October 2005

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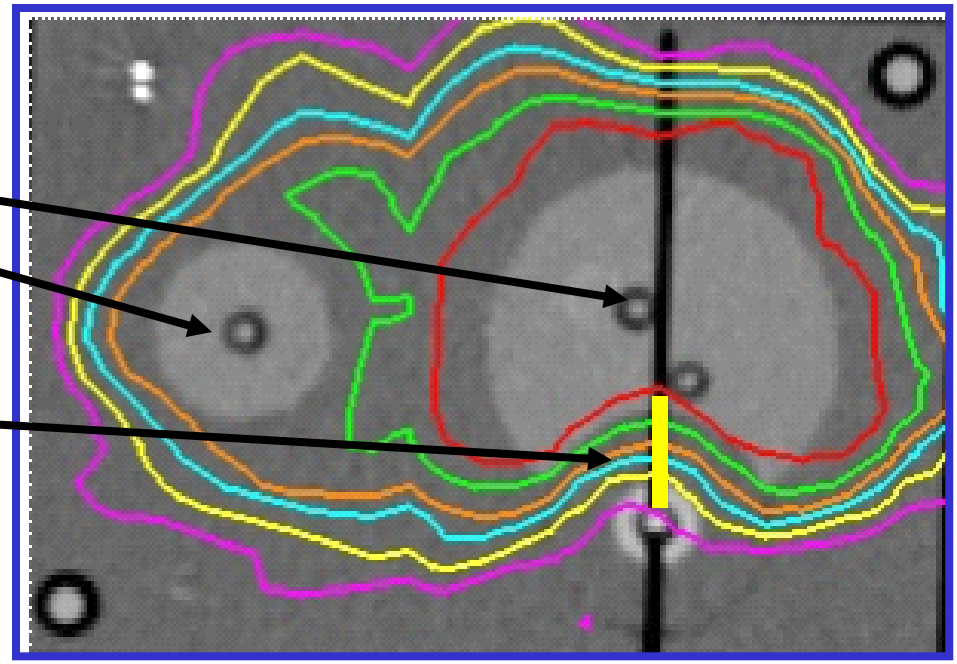
Criteria for credentialing

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



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IMRT H&N Phantom Results

- 212 irradiations were analyzed
- 153 irradiations passed the criteria
  - 44 institutions irradiated multiple times
- 59 irradiations did not pass the criteria
- 168 institutions are represented

Only 70% of institutions passed the criteria on the first irradiation.

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IMRT H&N Phantom Results cont.

- **37 failed by absolute dose only**
- **7 failed by DTA only**
- **15 failed by both absolute dose and DTA**

	1PTV	2PTV	DTA (mm)
mean	0.99	0.98	-0.3
std dev	0.075	0.063	3.4
count	620	308	211
range	0.34 – 1.13	0.62 – 1.22	-15 – 17

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Dose Criterion

42 institutions reported point dose measurements and criterion

Dose Criterion	Number of Institutions
2% - 3%	24
4% - 5%	18
> 5%	0

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DTA Criterion

22 institutions reported distance to agreement measurements and criterion

DTA Criterion	Number of Institutions
3 mm	16
4 mm	5
5 mm	1

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Dose adjustments based on QA

- 8 institutions adjusted MU delivered based on their QA
  - 4 of these institutions failed anyway
- 29 of the failing institutions reported making no changes based on QA measurements
  - 11 of these measured dose in the same direction as the failure

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 plan to account for dose differences measured with ion chamber

errors in couch indexing with Peacock system

2 mm tolerence on MLC leaf position

setup errors

target malfunction

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Changes made by institutions that resulted in acceptable phantom irradiation

input new output factors

remeasured PDD and modeled beam based on new values

adjusted leaf end modeling

updated software version

upgraded MLC leaves

more accurate setup

replaced target

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Conclusions

- **Measuring dose at more than 1 point may be useful**
- **Understanding your IMRT QA results is important**

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