

Experience with an IMRT Head and Neck QA Phantom

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Abstract

As the use of intensity modulated radiation therapy increases, national cancer study groups are beginning to initiate clinical trials that involve its use. It is important that the institutions in these trials administer IMRT consistently and accurately.

A Quality Assurance Office (QAO) has been funded by the NCI to assure the study groups that participants in clinical trials have adequate QA procedures and are not making dosimetry errors. For some trials, the QAO participates in credentialing of institutions.

The QAO developed a mailable anthropomorphic head and neck phantom used to evaluate the planning and delivery of IMRT. The water-filled phantom contained a polystyrene

insert that incorporated solid-water imageable structures representing a primary PTV, a secondary PTV and a critical structure. The insert held four TLD and a set of orthogonal radiochromic films. The phantom was used to demonstrate that doses were delivered accurately to the intended locations.

The phantom was mailed to eleven institutions to date. Instructions stated the prescribed doses to the PTVs and the limiting critical structure dose. Film profiles were scaled to TLD measurements and compared to the institutions' treatment plans. TLD results showed that in most cases institutions delivered doses to the primary PTV to within 5% of the intended dose. Doses in high gradient regions such as the critical structure varied from the intended dose by as much as 34% often with a displacement of over 5 mm.

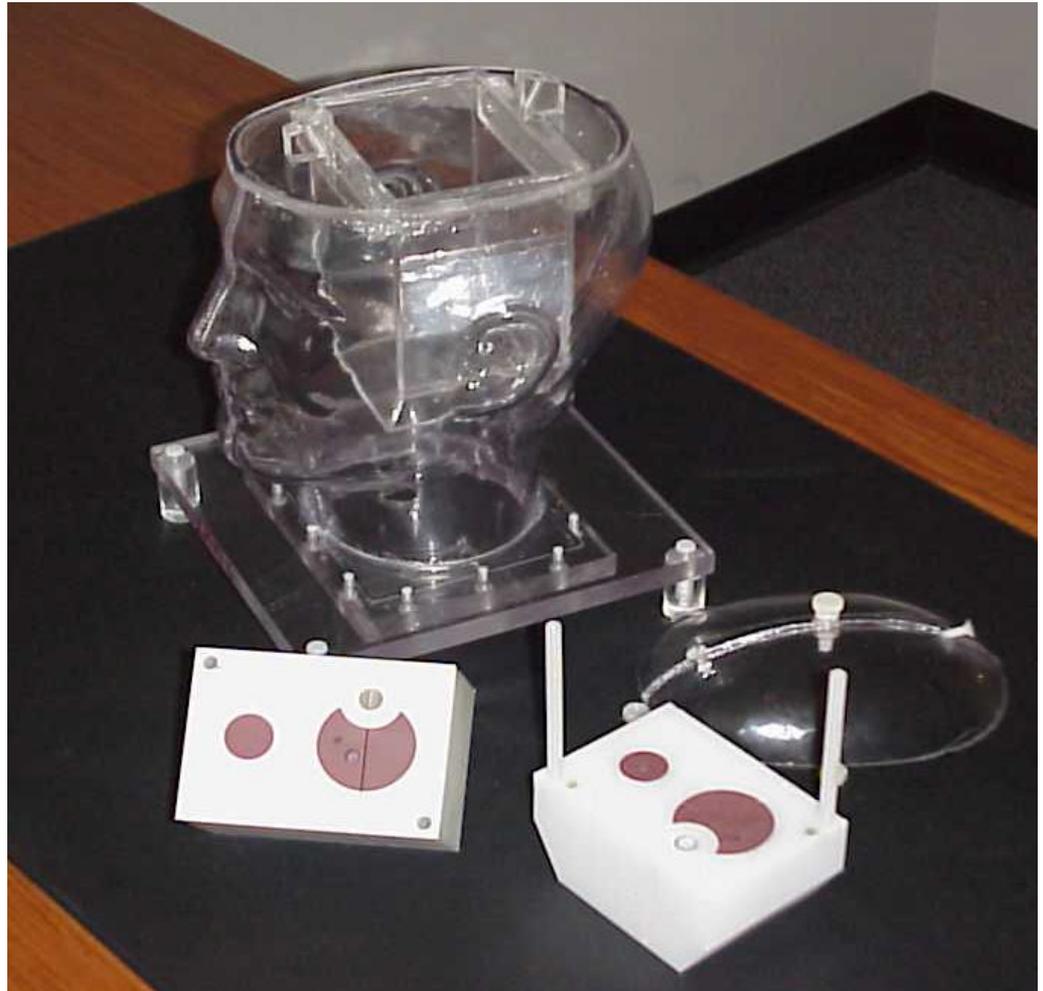
Phantom Description

- anthropomorphic
- water fillable
- mailable
- QA of entire process

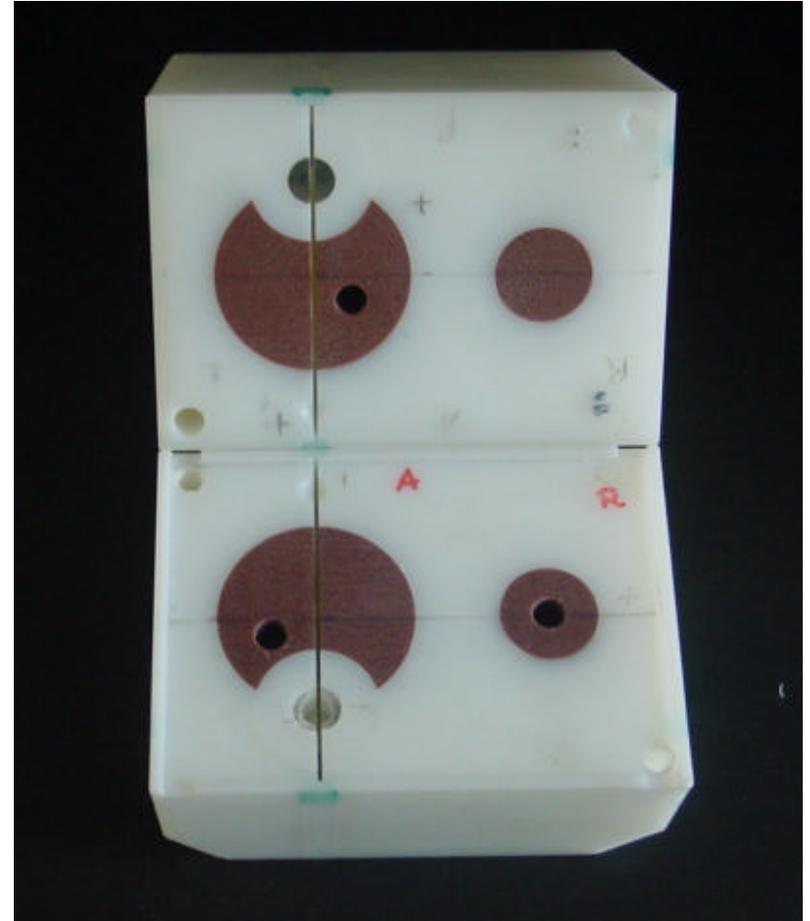
imaging

planning

treating



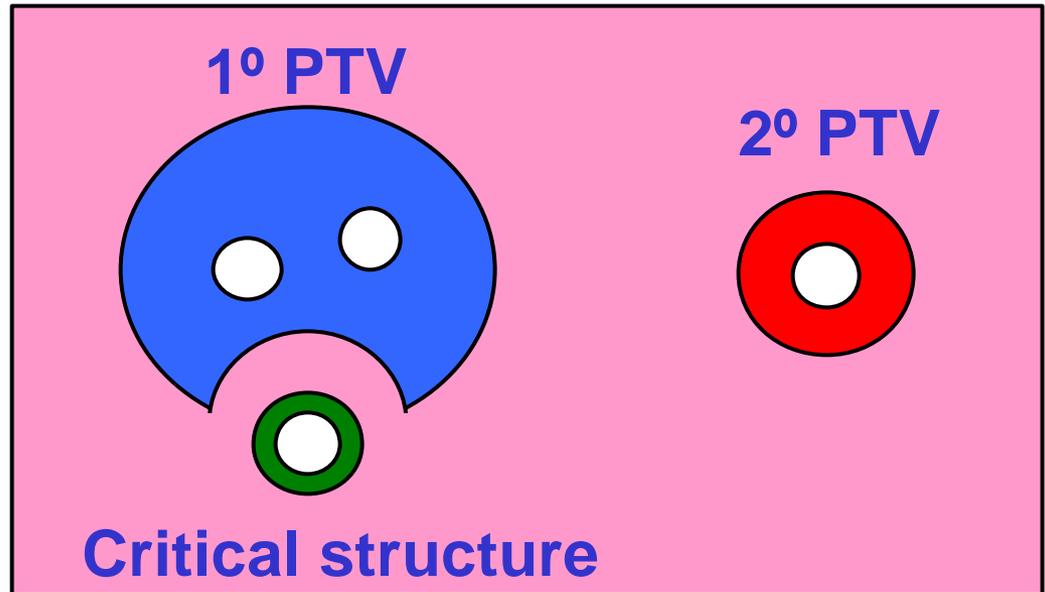
Phantom Pictures



The phantom shell and insert are mailed to the institution. The insert is placed in the phantom, and the phantom is filled with water. The phantom is imaged, a treatment plan is designed and the phantom is treated.

Phantom Insert

- Primary PTV
4 cm diameter
2 TLD
- Secondary PTV
2 cm diameter
1 TLD
- Critical Structure
1 cm diameter
1 TLD
- Axial and sagittal
radiochromic film



- 1° PTV treated to 6.6 Gy
- 2° PTV treated to 5.4 Gy
- critical structure limited to < 4.5 Gy

The insert is made of polystyrene. The primary and secondary PTVs are solid water and the critical structure is acrylic.

Representative IMRT Treatment Plan



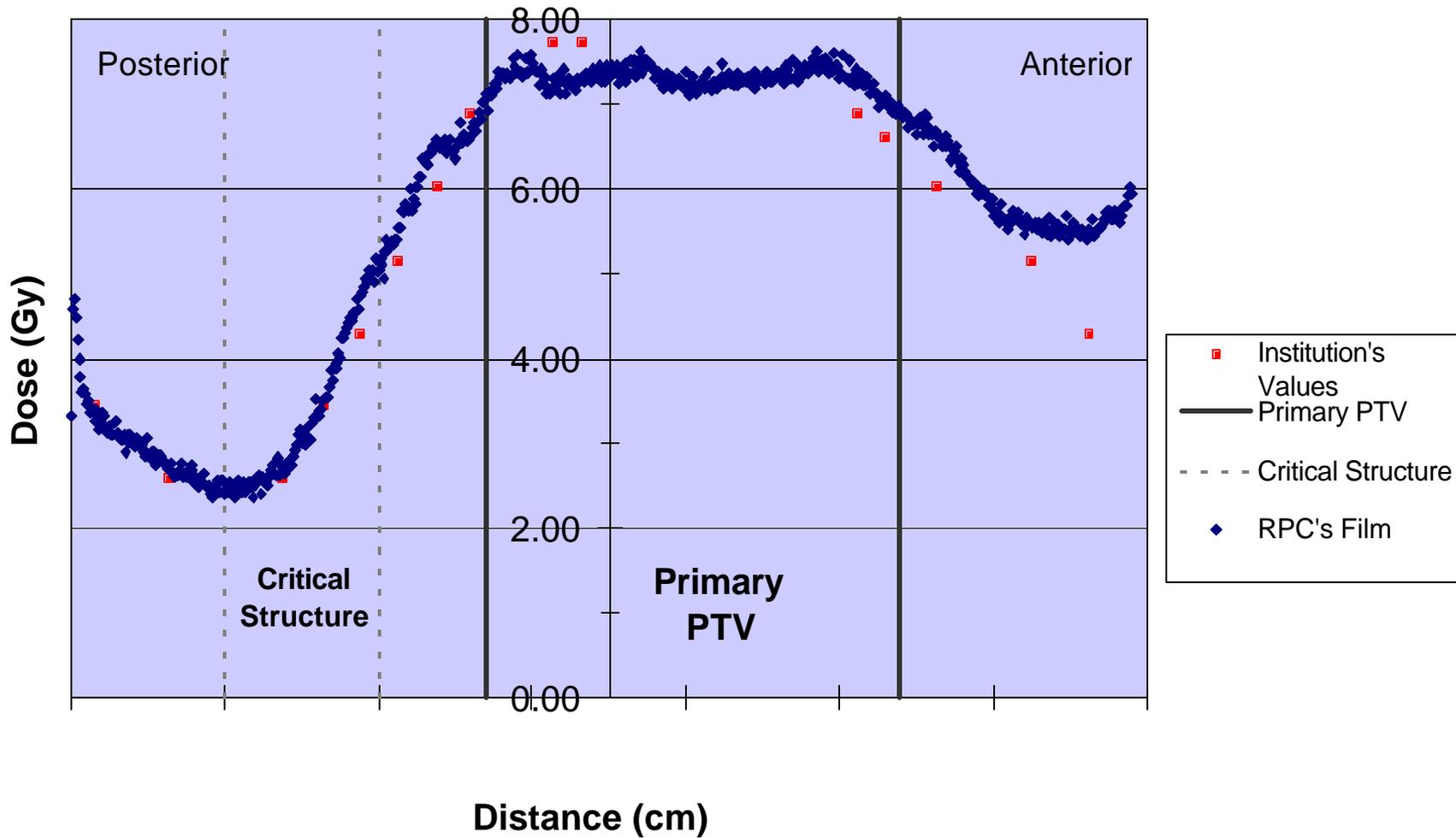
TLD Results

RPC/Institution

Institution	Primary PTV sup	Primary PTV inf	Secondary PTV	Critical Structure
1	0.97	1.04	1.10	0.99
2	0.93	0.96	0.93	0.82
3	1.04	--	1.01	1.16
4	0.96	1.00	0.98	--
5	1.01	1.03	0.99	1.10
6	1.02	1.03	1.00	0.95
7	0.98	0.98	0.97	0.88
8	1.04	1.04	1.06	1.09
9	1.04	1.05	1.04	1.18
average	1.00	1.02	1.01	1.02
% std dev	4.1%	3.2%	5.1%	13.0%

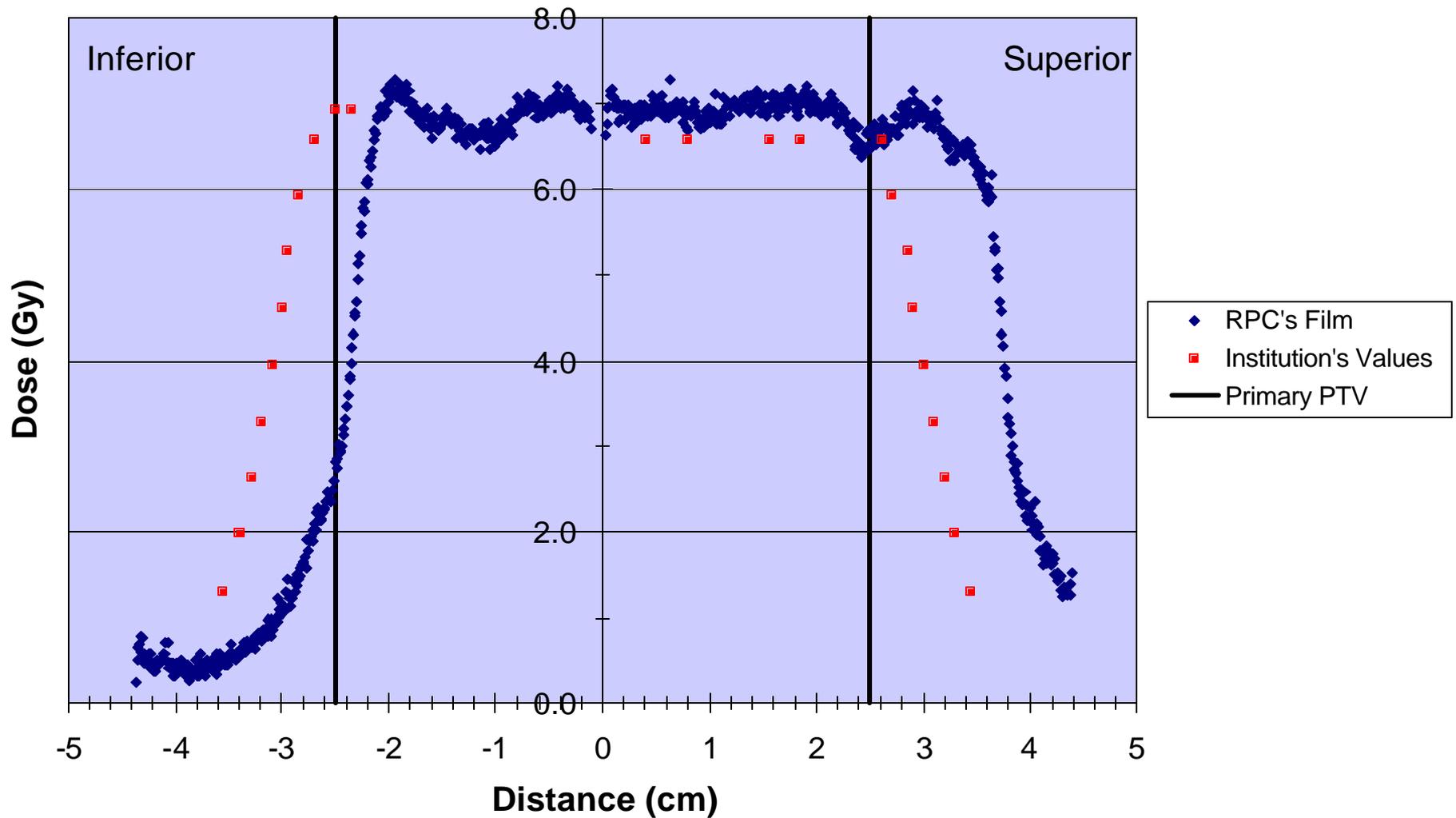
One of the ten original irradiating institutions is excluded from the TLD analysis because it did not report the minimum and maximum doses to the TLD volumes.

Anterior-Posterior Profile



The film is normalized to TLD results. Criteria for film are still being considered.

Superior-Inferior Profile



The film results show this phantom was shifted in the inferior direction relative to the treatment plan.

Criteria

TLD

- Primary and Secondary PTV $\pm 7\%$ (1.64•std. dev.)
 - Critical Structure $\pm 18\%$ (range)

Film

- criteria have not yet been determined

Conclusions

- A phantom has been made that can detect errors in planning and delivery of IMRT head and neck treatments.
- Evaluation criteria for the TLD results have been set.

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