

Purpose

To describe the Radiological Physics Center's new anthropomorphic liver phantom and to report the results from the initial irradiations.

Methods

A new imaging and dosimetry insert was created for the RPC's pelvic phantom. The polystyrene insert seen in Figure 1 represents the liver and includes two Solid Water™ targets (PTV1 and PTV2) that mimic liver metastases. PTV1, located in the superior-left-posterior region of the insert, is an ovoid 2 cm in diameter and 2.5 cm long. PTV2, located in the inferior-right-anterior region of the insert is a 3 cm diameter sphere. The insert houses one TLD and 2 planes of radiochromic film in each PTV. The insert fits into the previously designed pelvic phantom. The phantom, with a motion table to simulate respiratory motion, was sent to institutions planning to participate in RTOG 1112, an SBRT liver protocol. Institutions were instructed to design and deliver a stereotactic treatment plan that delivered 6 Gy to $\geq 95\%$ of each PTV. The maximum motion of the phantom on the motion table was 1 cm in the superior-inferior direction.

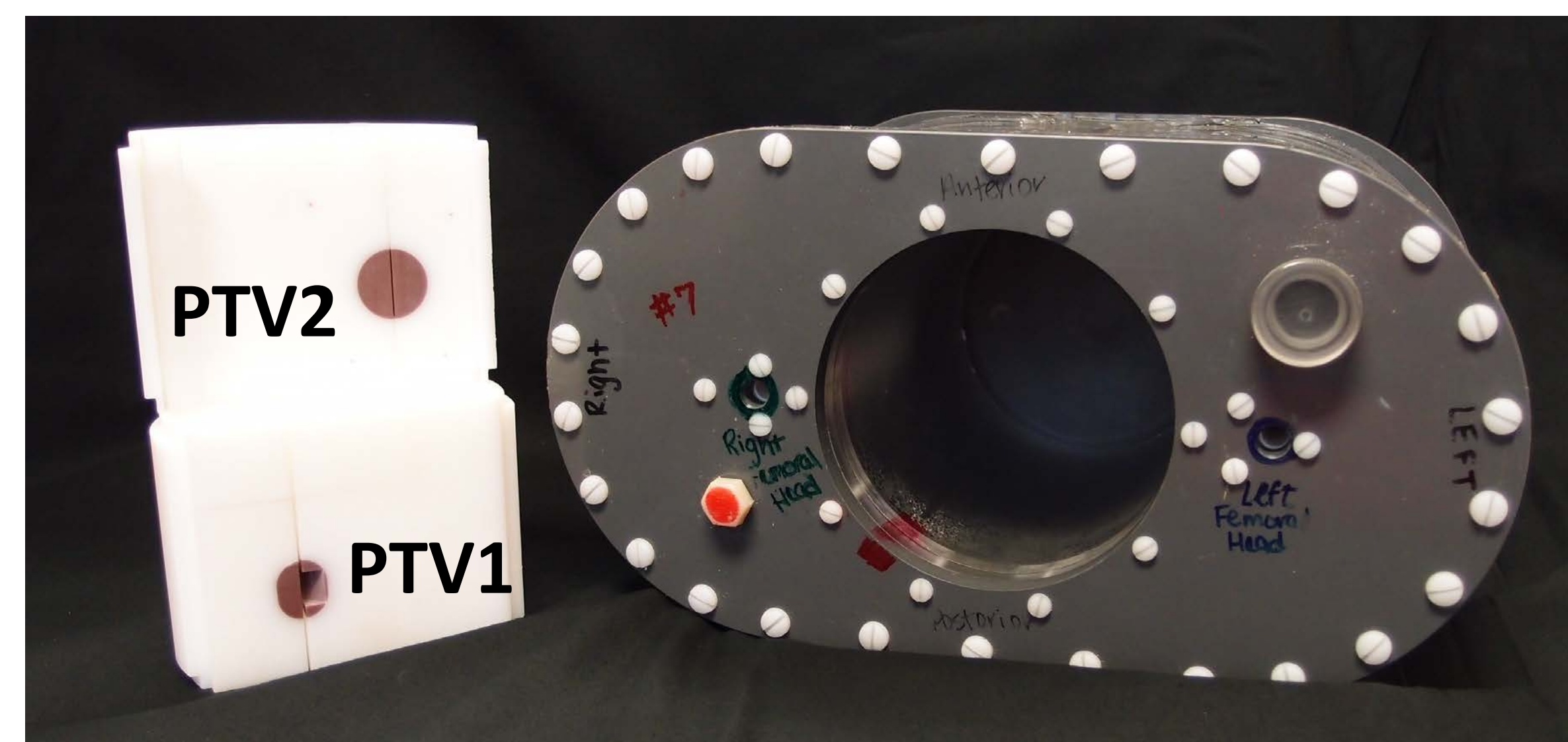


Fig 1: Picture of the liver phantom.

Results

19 irradiations from 17 institutions have been analyzed. The acceptance criteria, based on the results of the irradiations, were set at $\pm 7\%$ for the TLD and 85% of the pixels in a region surrounding each PTV passing a $\pm 7\%/4$ mm global gamma analysis. 11 of the 19 (58%) irradiations passed these criteria. Seven of the irradiations that did not meet the criteria failed to meet only the film criteria. One failed to meet both the film and TLD criteria. Eight of the failed irradiations had results from both PTVs that failed to meet criteria. Three irradiations failed to meet the criteria for only one of the PTV.

Breath hold, gating, ITV, and tracking techniques were used to account for motion. Eclipse, MultiPlan, Pinnacle, TomoTherapy and XiO treatment planning systems were used for planning. AAA, Adaptive Convolve, CC Convolution, Monte Carlo, and superposition dose calculations algorithms were used.

A representative plan for each PTV can be seen in Figure 2.

Average TLD and film results can be seen in Table 1.

| | PTV1 TLD | PTV2 TLD | PTV1 gamma | PTV2 gamma |
|-----|-------------|-------------|---------------|---------------|
| Avg | 0.98 | 0.99 | 88% | 89% |

Table 1: TLD and Film results.

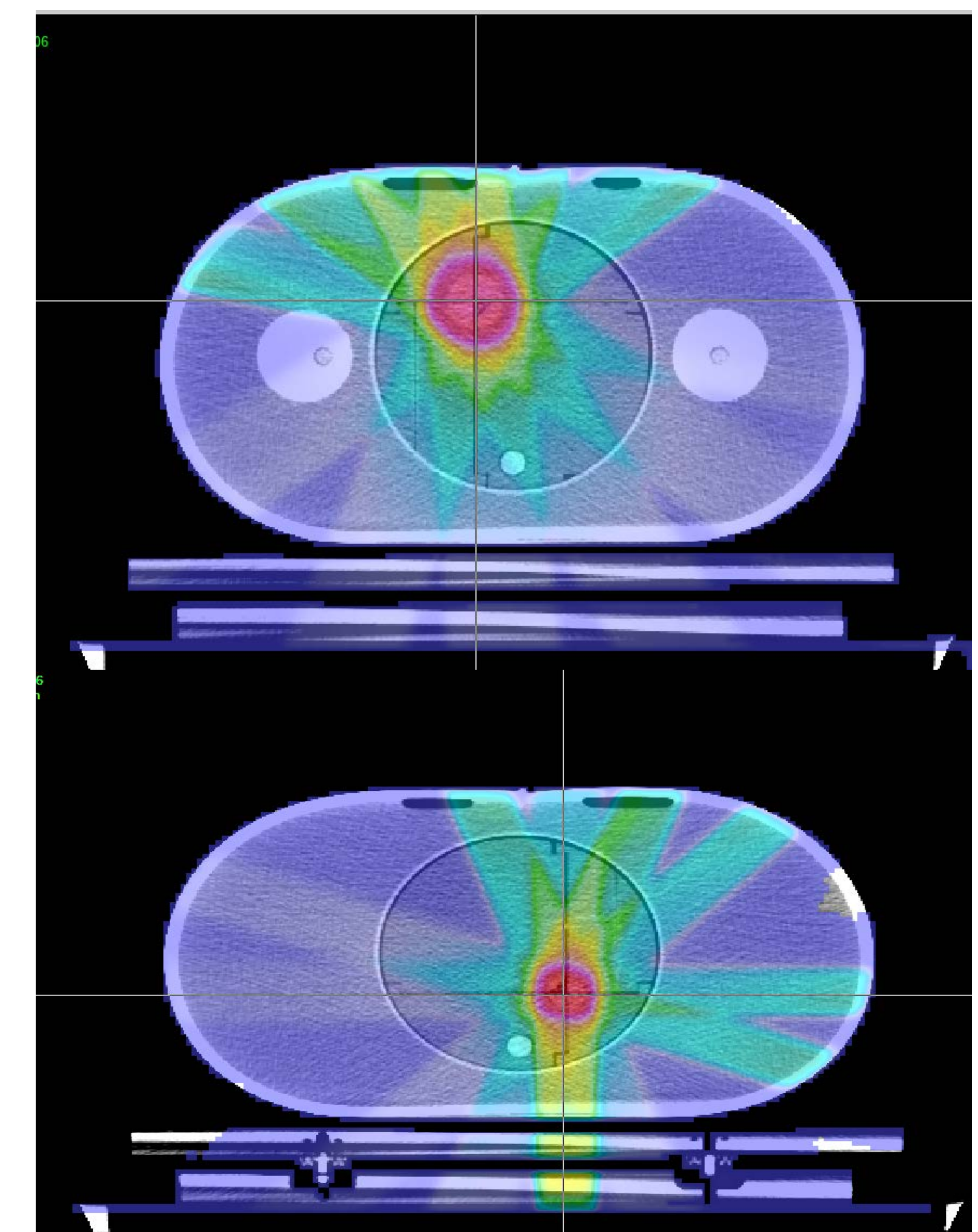


Fig 2: Representative plans for each PTV

Conclusions

The new liver insert along with a motion table tests the institution's ability to deliver dose to multiple moving targets and is a useful credentialing tool for clinical trials using SBRT.

Acknowledgements

Supported by PHS grant CA10953 and CA081647 from the NCI, DHHS.