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Development of a Head and Neck Phantom for Remote-audit program of IMRT Treatment

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Purpose: Accurate delivery of the most-up-to-date treatment techniques such as Intensity-modulated radiation therapy (IMRT) is essential. In order to conduct a remote-audit program, which allows evaluation of institution's accuracy in delivering IMRT, an anthropomorphic phantom has been designed and constructed. The dosimetric characteristics in the phantom were in vestigated.

Method: The phantom has a shape of cylinder with one target and three organ-at-risks (OARs) inside. The target and OARs were shaped analogous to those in nasopharynx cancer patients and were manufactured able to be detected in CT images. Inside the target and OARs, TLD holders were inserted for absolute dose measurements. The phantom allows measurements with thimble chambers at the TLD locations, thereby affording an inter-comparison between two dosimeters. For the measurement of relative dose distribution across the target and OARs, two film slots were orthogonally placed near the center of phantom. It also enables inhomogeneity insertion near the target. Measurement with TLDs and IC were done for three cases. The first was anterior one port 6MV X-ray (Primus, Siemens, USA) delivery to the phantom, the second was the same beam geometry but with inhomogeneties inserted, and the third was IMRT delivery to the phantom without inhomogeneities. For each case, four sets of TLDs were measured to reduce the statistical uncertainty.

Results: In anterior one port X-ray delivery to homogeneous phantom, the deviation between the IC and TLD measurements normalized to IC dose, ranged from 1.13% to 3.9%. With inhomogeneous insertion, the range increased to 2.7%-3.4%. In IMRT delivery, the differences between IC and TLD measurements were 0.2-5.6%. Standard deviation of TLD measurements were small, that ranged from 0.4% to 1.2%.

Conclusion: Our preliminary results show the developed phantom allows the measurements with TLDs and IC within 4% uncertainty. More investigation is necessary to reduce the uncertainty range.

Keywords : IMRT, Phantom, Head and Neck Cancer