AbstractID: 4632 Title: A 4D IMRT QA Device

Purpose: Many radiation therapy targets move during treatment. Some emerging technologies allow clinicians to accurately define and prescribe to "Tumor Motion Envelopes" (TME). In the case of IMRT delivery, clinicians must consider the temporal nature of the modulation in association with the target motion within the TME. There is a need for a 4D IMRT QA device that can incorporate and analyze customized intrafractional motion.

Method and Materials: (X, Y, Z)(T) coordinates representing a motion kernel were entered into a software application. The software transformed the kernel into a beam-specific projection, previewed the motion in real time, and drove a precision X-Y motorized device. An existing planar IMRT QA measurement device (MapCHECK) was mounted on the device. The subset of measurement positions that intersected the target in the beam's-eye-view of a single phase of the breathing cycle were defined as "tumor-rays" and analyzed for dose uniformity between multiple fractions.

Results: In the first efficacy study, two lung patient target motion kernels were derived from 4D CT studies. From each kernels, a TME was formed by convolving the motion kernel with the single-phase target volume. Dose was prescribed to the TME and delivered with open fields and three IMRT modalities – solid modulators, SMLC, and DMLC – for comparison. The 4D IMRT QA device effectively collected tumor-ray data and allowed the analysis of degradation in dose uniformity due to a moving target within a static TME. Gating techniques were considered as well.

Conclusion: The combined software and hardware solution for customized 4D IMRT QA proved to be an effective tool for assessing IMRT delivery under conditions of intrafractional motion. It was also an interesting tool for the assessment of delivery gating.

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