AbstractID: 7507 Title: Breathing motion-induced dose delivery error evaluations as applied to Tomotherapy dose delivery

Purpose: To develop a method for evaluating breathing motion-induced dose delivery errors in Tomotherapy dose delivery.
Methods and Materials: Dosimetric inaccuracy can result from breathing-induced tumor motion in Tomotherapy treatment delivery. Patient breathing motion patterns were simulated using quantitative spirometry-measured patient tidal volumes and converting the tidal volume to tumor motion by varying the ratio of tumor motion to tidal volume for 34 patients. Simulations of Tomotherapy deliveries were conducted modifying the previously published techniques by using measured beam profiles instead of step-function fluences, and couch speeds typical of Tomotherapy treatments. Radiochromic film and our in-house 4D phantom were used to verify the algorithm.
Results: As expected, the breathing motion blurred the dose distributions, but slow drifts in the average tissue position caused detectable dose errors. The dose errors were expectedly largest with the smallest (1.0cm) field size, and could be >10% for motion amplitudes comparable to the field size. As the field width increased relative to the motion amplitude, and as couch-speed (pitch) decreased, the error also decreased, and as such these settings may be preferable for patient treatments. These slow drifts occurred over time periods that were coincident with the amount of time required for the field to pass a stationary point. Measurements agreed with the simulation.
Conclusions: Previous breathing motion studies did not use real patient breathing patterns and therefore did not consider the impact of slow, relatively small drifts in those patterns. The drifts change direction during the breathing measurement, causing dose errors that are both positive and negative. While the individual dose fraction errors can be >10%, they are unlikely to occur in the same place each day, so the average dose is likely to be consistent with earlier studies.
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