

AbstractID: 10877 Title: Evaluating the accuracy of four-dimensional photon dose calculations with phantom measurements

Purpose: Respiratory motion can cause deviations between the intended and delivered dose distributions. Recent work has focused on developing four-dimensional (4D) dose calculation algorithms, which explicitly account for respiration in the dose calculation process. Before these dose calculations methods can be used clinically, it is necessary to verify their accuracy. The purpose of this study was to evaluate the accuracy of 4D dose calculations with phantom measurements.

Methods: Measurements were made using two anthropomorphic phantoms: a rigid moving phantom and a deformable phantom. Two motion patterns were designed to drive both phantoms: a sinusoidal motion pattern and an irregular motion pattern that was extracted from a patient breathing profile. Three plans were generated on each phantom: a single-beam, a multiple-beam, and an IMRT plan. Doses were calculated using the 4D dose calculation capabilities of a commercial radiation treatment planning system. Each plan was used to irradiate the phantoms, and doses were measured using TLD and radiochromic film. The measured doses were compared to the 4D-calculated doses using a measured-to-calculated TLD ratio and a gamma analysis. For the TLD and film, relevant passing criteria (5% for TLD and 5%/3mm for gamma) were applied to determine if the 4D dose calculations were accurate to within clinically acceptable standards.

Results: All of the TLD measurements met the passing criteria. 42 out of the 48 evaluated films passed the gamma criteria. The films that did not pass the gamma criteria were from the irregular moving rigid phantom.

Conclusions: In controlled conditions, 4D dose calculations are accurate to within clinically acceptable standards. In clinical terms, this means that if patient breathing is reproducible, 4D dose calculations will produce accurate dose distributions. Conversely, irregular breathing can produce inaccurately calculated 4D dose distributions.

Conflict of Interest: This work is partially supported through an SRA with Philips Healthcare.