AbstractID: 8266 Title: Potential dosimetric benefits of four-dimensional radiation treatment planning

Purpose: Four-dimensional (4D) dose calculations involve computing radiation doses on each phase of a 4D computed tomography (CT) image data set, deforming the dose matrices based on the deformations needed to register each phase with a reference phase, and accumulating the doses on the reference phase based on these deformations. The purpose of the present work is to determine the extent of dosimetric differences between conventional three-dimensional (3D) dose calculations and 4D dose calculations based on deformation of organ models.

Methods and Materials: 4D dose calculations were performed on a set of 15 patients with Stage III non-small-cell lung cancer using a model-based deformable registration algorithm on a research version of a commercial radiation treatment planning system. Patients were planned using internal target volumes based on explicit motion of the clinical target volume in the 4D data set and setup margins based on clinical practice. Target volume coverage as well as doses to critical structures calculated using the 4D methodology were compared to those calculated using conventional 3D methodology.

Results: For 11 of 15 patients, CTV coverage was comparable in the 3D and 4D calculations, whereas for 7 of 15 patients, PTV coverage was comparable. For the other patients, the 4D calculation indicated a sufficient difference in target volume coverage so that replanning should have been done. No correlations could be established between 3D and 4D differences and GTV size or extent of GTV motion. Negligible differences were observed between 3D and 4D dose-volume relationships for normal anatomic structures.

Conclusions: To ensure that target volumes are not underirradiated when respiratory motion may affect the dose distribution, 4D dose calculations should be performed.

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