Purpose: Dual-gated intensity modulated radiation therapy (DG-IMRT) is a novel delivery method for speeding respiratory-gated IMRT delivery in which dose is delivered during both inhale and exhale windows. To determine the feasibility of designing DG-IMRT plans using current clinical treatment planning systems, we design and evaluate a lung patient plan using Eclipse.

Methods: Tumor target volumes were contoured on inhale and exhale CTs for a lung cancer patient with ~1mm motion. Separate 5-field IMRT plans were optimized in Eclipse for the inhale PTV on the inhale CT and for the exhale PTV on the exhale CT. The inhale plan dose was mapped to the exhale geometry using several deformable medical image registration methods, and the two doses were summed to produce the DG-IMRT dose. The accumulated dual-gated dose for the best performing registration is presented.

Results: Though the dual-gated inhale and exhale plans meet clinical requirements, the accumulated dual-gated dose performs quite poorly. Examination of the deformations indicates that only about two-thirds of the voxels within the inhale PTV map to voxels within the exhale PTV, indicating an unacceptably low level of physiological accuracy.

Conclusion: It is possible to design dual-gated plans in Eclipse, but there is currently no accurate means of evaluated the summed dose. Furthermore, our results underscore the need for image registration methods that accurately model underlying tissue deformations before they can be used for dose accumulation in the presence of organ motion.

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