AbstractID: 10776 Title: Motion-weighted dose-volume histogram: a more meaningful and practical four-dimensional planning and evaluation method

Purpose: 4D-CT is frequently utilized by radiation oncologists to delineate a tumor and account for its motion. Current methods to generate the PTV do not fully utilize the 4D image data. After expanding from ITV to PTV, the 4D information is partially lost as the specific volume occupied by a tumor in any given respiratory phase is no longer apparent. Therefore, the planning process is the same as in 3D static planning. The 4D dosimetry introduced here uses a different method to delineate PTV (called "IPTV" in this work), which carries all of the 4D information into the planning process. This motion-weighted IPTV allows generation of motion-weighted DVH's. **Method and Materials:** Our new method expands the GTV to a CTV and PTV on each individual respiratory phase and makes a union of all the PTV's to create the IPTV. Different sub-volumes of the IPTV are assigned different importance in treatment planning. Volumes occupied by PTV throughout the entire respiratory cycle receive higher dosimetric priority than those occupied by PTV only a fraction of the time. Coordinates of the center-of-mass of each PTV volume are used to calculate a motion vector for each phase. These motion vectors are used for motion-weighted dose calculation based upon the 3D dose distribution. Motion-weighted DVH's are generated from the motion-weighted dose. The same process can be applied to normal structures. **Results:** Motion-weighted dose distribution differs from 3D dose distribution for both target volumes and normal structures. Reducing coverage to volumes of high PTV occupancy worsens the DVH more than reducing coverage to regions of low occupancy. **Conclusions:** By altering the current ITV to PTV expansion method and weighting the dose with motion, 4D dosimetry can be realized with current planning systems and used to improve treatment plans and generate more realistic DVH's of mobile structures.