AbstractID: 8389 Title: Using respiratory tumor motion as a degree of freedom to improve 4D IMRT plans

Purpose: Instead of seeing respiratory tumor motion as an obstacle to precise planning and delivery, motion can be viewed as an additional degree of freedom in improving radiotherapy. Using 4D approach, the dose from a given beam angle can be spread over different parts of normal tissues, particularly serial structures such as the spinal code and esophagus, while targeting the moving tumor. Consequently, the maximum dose to normal structures for the 4D plan can be lower than when the motion inclusive or gated treatments are used. The aim of this work was to utilize anatomic motion to improve IMRT plans.

Method and Materials: For a 4D CT scan of one lung cancer patient (tumor motion of 2.1 cm and volume of 3 cm^3), an IMRT plan was created. Three beams were chosen with the beam angle arrangement as follows: the first beam passed through the spinal cord to the tumor, the second passed through the esophagus to the tumor, and the third passed through the tumor only. Four different approaches were applied: (1) gated at exhale (GE), (2) gated at inhale (GI), (3) motion inclusive (MI), and (4) 4D.

Results: The mean and maximum doses to serial structures are significantly decreased in the 4D plan, compared to other three plans. The dose received by 5% of volume is reduced by 38%, 40%, and 36% for the spinal cord and 29%, 33%, and 35% for the esophagus in the 4D plan, compared to the GE, GI, and MI plans, respectively.

Conclusion: Taking advantage of respiratory tumor motion as an additional degree of freedom can substantially improve target coverage and spare normal tissues. Up to 40% and 35% reduction in the high dose area of the spinal cord and esophagus, respectively, was observed with 4D IMRT planning.

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