AbstractID: 8229 Title: Radiobiological evaluation on the four-dimensional stereotactic radiotherapy plan

Purpose: To evaluate the four-dimensional (4D) stereotactic radiotherapy plan for the lung patient using biologically effective uniform dose (BEUD) and to compare this 4D treatment plan with MLC-based intensity modulated radiation therapy (IMRT) plans for fixed respiratory phases.

Method and Materials: One patient with lung cancer, who was previously treated with stereotactic body radiotherapy (SBRT), was chosen to re-planned with the 4D stereotactic radiotherapy technique using the Pinnacle3 treatment planning system. The 4D treatment plan was developed based on a set of 4DCT images divided into ten respiratory phases. Doses to the target were prescribed as 3 fractions of 16 Gy to 95% of planning target volume (PTV). BEUD calculation was performed to evaluate the final composite 4D dose distribution.

Results: For this dose prescription, the complication-free tumor control probability, P_+ value, is 78.6% for the 4D stereotactic plan with a mean dose of 49.9 Gy to PTV and the BEUD of 49.9 Gy as well. The total control probability, P_B, is 98.5% and the total complication probability, P_I, is 20% due to high maximum dose to the lung, which is proximal to the PTV. When compared with fixed-phase IMRT plans, the dose distributions were very similar; the P_+ value of the 4D plan, however, was higher, but was not substantially different from values of fixed-phase plans.

Conclusion: From our radiobiological analysis of this lung SBRT case, the 4D plan was superior, but not significant improved from MLC-based IMRT plans for fixed phases. Not only the mean doses to PTV of these plans were very close, but also were P_+ and BEUDs of these plans. Dose distributions of the 4D plan can be further optimized to a maximum P_+ of 86.5% when achieving $BEUD_B$ of 42.95 Gy by sparing the lung to make P_I reach as low as 7.2%.