AbstractID: 9164 Title: The impact of breathing-motion and tumor regression on dose-volume metrics used for outcome analyses

Purpose: Breathing motion and tumor regression may affect the correlation between derived treatment planning dose-volume metrics and local control, especially for lung tumors. We investigated this effect for 3-D plan archives that use older computed-tomography scanning protocols that effectively averaged over multiple breathing cycles.

Method and Materials: To simulate tumor motion due to breathing, we convolved the static planned dose distribution with a probability distribution function (PDF), which describes the nature of GTV motion due to breathing, thereby creating breathing motion weighted dose distributions. To simulate tumor regression, a mathematical model based on experimental observations of NSCLC tumor regression (Ramsay et al., IJROBP (2006) 64(4):1237-44) was applied, with the additional needed assumption that cell loss is uniform, to describe the decrease of GTV volume and track dose through the treatment. Datasets from two patients, one with a large GTV volume (315.3736cc), the other with a GTV volume (0.6644cc) were used. Monte Carlo recomputed dose distributions were used for improved dosimetric accuracy. GTV DVHs incorporating breathing motion, and incorporating both breathing motion and tumor regression were derived to estimate 'true' DVHs.

Results: For the small tumor, the effect of breathing dominated, and the 'true' GTV was worse than the planned GTV (D98 decreased by 2.27%). For the large tumor, the effect of regression dominated and the 'true' dose distribution was significantly better than planned dose distribution (D98 increased by 1.2%). Of these two effects, tumor regression generally had larger impact.

Conclusion: Breathing and tumor regression are likely to be confounding factors when retrospectively analyzing lung treatment plans for tumor control probability analyses. A model has been developed to account for these effects in an approximate fashion. This model will be tested for an ability to potentially improve correlations between derived metrics and local control.

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