Purpose: To measure quantitatively in-vivo shrinkage of gross tumor volume (GTV) using CT imaging and model GTV as a function of delivered dose during treatment.

Methods: The GTV of three selected non-small cell lung tumors were outlined on CT images acquired weekly during treatment course with regular fractionated regimens of 180 cGy over 35 fractions. These patients have well defined lesions in the middle of the lung where the GTV has high contrast compared to lung and other tissues. The GTV variations were measured as a function of delivered dose. Then, GTV-dose curves were fitted with three exponential functions with linear and linear-quadratic dose dependence that decreases to zero or certain residual volume levels.

Results: The GTV shrinks exponentially as a function of dose through the treatment course. However, the GTV does not decrease to zero volume by the end of treatment. Among the three different formulas used to fit the GTV-dose data, it was found that the exponential function that decays linearly with delivered dose to a certain volume level provides the best fitting formula of the GTV shrinkage. Alpha obtained from non-linear curve fitting of the three patients varied by less than a factor of 2. The normalized residual volumes were within a factor of 3 and was not influenced by the initial GTV’s which varied by more than a factor of 20.

Conclusions: Neither a simple exponential function with a linear dose decay nor a complicated exponential function with linear-quadratic dose decay, fit well GTV response as a function of dose through the treatment course. The linear exponential decay function to non-zero volume level provided the best fitting formula to GTV-dose data. This might be due to the necrotic core of the tumor that is less responsive to radiotherapy.