AbstractID: 12653 Title: Does the shape and size of clinical target volume affect the planning target volume margin?

Purpose: Recipes for margin design generally depend on clinical target geometric variation/motion characterization (the mean and the Standard Deviation). Tumor specific geometry was not considered. This study is to investigate the influence of the shape and size of a CTV on the design of non-uniform margin.

Method and Materials: Criterion of the target margin design is to ensure that at lest 95% probability of CTV occupancy is inside the PTV. The random error and the systematic error were considered separately in our margin calculation. Target margins are represented by $k_{r\text{-}95}\sigma_r$ and $k_{s\text{-}95}\sigma_s$ for compensation of the random error and the systematic error respectively, where $k_{r\text{-}95}$ and $k_{s\text{-}95}$ are coefficients, σ_r and σ_s are the SDs of the random error and the systematic error. We evaluated the value of $k_{r\text{-}95}$ and $k_{s\text{-}95}$ for CTVs with different shape and size. The shapes of CTV were chosen as point, sphere, cylinder and concave shapes.

Results: For the random error, $k_{r\text{-}95}$ is 2.79 for the point CTV. For the sphere CTVs, $k_{r\text{-}95}$ is in the range of (1.65, 2.79). The upper and lower bounds correspond to the sphere size with zero and infinite large radius. The $k_{r\text{-}95}$ for the cylinder CTV is in the range of (1.65, 2.45), the actual value for any surface point depends on its position and cylinder size. For points at the concave region, $k_{r\text{-}95}$ depends on the local shape, and it could be less than 1.65. For systematic error, no matter what the shape and size the CTV is, the $k_{s\text{-}95}$ is always 2.79.

Conclusion: In addition to the random error of target position variation, the target margin also depends on a CTV's shape and size. However, for the systematic error of target motion, the shape and size of a CTV have no effect on the target margin design.