AbstractID: 6862 Title: IMRT optimization using a shifted CTV-based objective function

Purpose: The Planning Target Volume (PTV) is used to ensure that the CTV is adequately covered with the prescribed dose despite geometric uncertainties. Clinically, a plan is acceptable if the 95% isodose surface covers the PTV; therefore the objective function is currently formulated based on PTV for IMRT optimization. This study investigates the feasibility of using a CTV-based objective function for IMRT optimization in shallow tumors where the PTV extends into build-up region.

Method and Materials: For a selected shallow tumor (Head & Neck) case, a conventional IMRT plan was optimized with a PTV-based objective function using Newton's algorithm. The CTV-PTV margin was 10mm. Additionally, a CTV-based objective function calculated from 6 different isocenter shifts (10mm positive and negative on each axis) was used for optimization to generate another plan. To ensure that the treatment plan is acceptable for the whole range of possible movements, the resultant objective function is formulated so that the worst plan among shifted plans is acceptable:

$$OF=\max(OF_i)_{\text{i of isocenter set}}$$

The PTV DVH and CTV DVHs were analyzed for both plans.

Results: Using PTV-based optimization results in better PTV coverage than that of CTV-based optimization: V95=93.4 % in comparison with V95=80.9%. However, in the case of CTV-based optimization, the maximum dose of the CTV for all isocenter shifts is less than 108% in contrast with 136% using PTV-based optimization. Furthermore, the intensity patterns from the CTV-based optimization plan are less complex than those from the PTV-based optimization.

Conclusion: The current method of optimization using a PTV-objective function might lead to an overdosage of the CTV for shallow tumors due to the build-up region. The CTV-based objective function has been shown to be a possible solution in reducing the skin dose with IMRT optimization for shallow tumors where the PTV extends into the build up region.