AbstractID: 10889 Title: Incorporating geometric uncertainties into IMRT optimisation for prostate cases using a multiple isocenter CTV-based (miCTV-based) objective function

Purpose: To incorporate geometric uncertainties directly into the inverse planning process using a multiple isocenter CTV-based (miCTV-based) objective function for prostate cases.

Method and Materials: A CTV-based objective function OF_i is calculated at each of N isocentre shifts, chosen to cover the probably geometric uncertainties. A power-law weighted average $OF=(1/N*\Sigma_{i=1..N} OF_i^b)^{1/b}$ was calculated; the use of this function enables us to weight the function to be dominated by the worst of the OF_i, to ensure that an acceptable plan is obtained at each isocentre shift. Each OF_i was calculated in the same way as the PTV-based objective function but using the CTV instead.. For each of four prostate patients, two plans were calculated; one with the miCTV-based OF with N=62, the other with a PTV-based objective function. Plan analysis considering geometric uncertainties was carried out using the dose volume population histogram (DVPH) concept.

Results: For all plans, the CTV DVPHs showed that miCTV-based plans are as good as PTV-based plans. However, rectal DVHs from miCTV-based plans were better than those from PTV-based plans when evaluating the V95, V90 and V75 values for all cases except the V95 for one patient. These differences can be significant in cases where the evaluation points V95, V90 and V75 are close to their limits. In patient 3, the PTV-based plan resulted in V90=31.2% from the rectal DVPH with 90% confidence level, which violated the constraint V90<30%. The use of the miCTV-based objective function resulted in a better plan with V90=28.5%, which is acceptable.

Conclusion: For prostate cases, miCTV-based plans have been shown to be superior to conventional PTV-based plans at reducing rectal doses. A lower rectal dose in miCTV-based plans compared to PTV-based plan indicated that a better compromise between the target coverage and rectum sparing were obtained using the miCTV-based objective function.