

Purpose:

The adaptive radiotherapy involves replanning process based on daily computed tomography(CT), which is impractical with the manual recontouring and trial-and-error replanning process. An automated adaptive planning(AAP) method, i.e. automated contouring and automated plan optimization without any manual intervention, was proposed and validated for IMRT and SmartArc planning to account for inter-fractional changes in prostate cancer.

Method and Materials:

9 CT datasets (simulation CT and 8 daily CTs) of a prostate cancer patient with large daily anatomical changes were selected. In the AAP method, contours on each daily CT were automatically generated by mapping the contours from simulation CT using Demons Image Registration. An in-house developed automated planning method was used to generate the initial, the replanned IMRT and SmartArc plans. The final treatment plan evaluation was based on physician-drawn contours on simulation CT and each daily CT. The cumulative dose-volume-histograms(DVHs) of the target and the normal tissues were acquired by averaging the DVHs based on the physician-drawn contours of each daily CT and compared to those of the initial plans recalculated just by shifting the isocenter.

Results:

After adaption using AAP, the percentage volume covered by prescription dose for prostate and SV reached 98.8% and 96.7% for IMRT, and 97.2% and 95.5% for SmartArc, which was an absolute increase of respectively 10.8% and 15.3% for IMRT, and 5.4% and 10.9% for SmartArc plan compared to shifting-iso method. The V70 and mean dose for rectum were 10.7% and 40.5Gy for IMRT, and 10.3% and 33.3Gy for SmartArc, an absolute reduction of 10.3% and 8.5Gy for IMRT, and 10.8% and 6.8Gy for SmartArc, compared to shifting-iso method.

Conclusion:

The AAP method, which is fully automated, is practically effective for on-line compensation of the target dose deficit and critical organ overdose caused by inter-fractional anatomical change for prostate cancer.