

Plan Degradation in Head and Neck Cancers

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Abstract:

Purpose/Objective(s): Our image guided radiation therapy (IGRT) system couples a linear accelerator with a CT-onrails, which offers the advantage of diagnostic CT quality images for IGRT guidance. Using our IGRT system, we undertook a detailed analysis of the impact of patient setup and tissue volume changes on dose delivery for head and neck (H&N) cancers.

Materials/Methods: H&N cancer patients, each of whom had weekly isocenter checks (isocheck), were identified by retrospective chart review. So far a total of 30 CT scans have been analyzed. To quantify the inter-isocheck setup error, patients' linear and rotational positions were measured. The left/right (L/R), inferior/superior (I/S), and posterior/anterior (P/A) isocenter displacements were measured. For rotational displacement, the angle between the axes, each of which connects the center of the vertebral body and the spinous process at the isocenter level, in the isocheck CT and the planning CT was measured. Also, tumor and lymph node volume changes were calculated for isocheck and planning CT data sets. To evaluate the effects of patient setup error and tissue volume changes, the original plan and region of interests were copied to a phantom of each isocheck CT data set. To assess if IGRT can mitigate these effects, each isocheck data set was evaluated by either shifting the isocheck images to correct for any linear displacements or left unaltered. Dose volume histograms (DVHs) were calculated and compared for each treatment plan.

Results: Mean L/R, I/S, and P/A isocenter displacements are 3.6 mm, 2.5 mm, and 3.8 mm, respectively. Average rotational displacement was 3.6°. Tumor volume decreased to ~70% and ~25% of original size by week 3 and 6, respectively. Lymph node volumes decreased to ~40% of original size by week 3. Without altering patient setup, DVH analysis showed an increase in dose of 3%, 12%, and 16% to the tumor, cord, and parotids, respectively. With patient shifts to correct for setup errors, accurate dose delivery to the tumor was achieved. However, even with shifts, the cord and parotids were still overdosed by >10%. Detailed analysis of this data will be presented.

Conclusions: Our findings suggest small linear and rotational displacements can manifest as significant effects on dose delivery to critical structures. Tissue volume changes in H&N cancers may require at least one replanning and as early as week 3 of treatment. IGRT using superior quality images of diagnostic CT can accurately detect when replanning becomes necessary.