Purpose: To quantify the effect of using the planned dose distributions in lieu of performing dose recalculations on daily in-room images for adaptive radiotherapy (ART) dose assessment of head and neck cancer patients.

Methods: 16 patients with cancers of the head and neck were treated using the TomoTherapy Hi-Art II (Accuray Inc., Sunnyvale, CA). Images of all patients were acquired prior to each treatment using the megavoltage CT (MVCT) capability of the TomoTherapy unit. Overall, images from 528 fractions were evaluated. For every image set, the delivered dose was estimated by both recalculating the dose distribution using the acquired MVCT and also by simply overlaying the planned distribution on the new images. ART dose assessment was performed using deformable image registration (DIR) to deform contours from the treatment plan to the images acquired during each fraction and to accumulate the estimated dose delivered during each fraction back to the reference treatment plan. The same DIR maps were applied to both dose estimation methods. Dosimetric endpoints were then compared between the DVHs computed using the recalculated or planned dose distributions.

Results: The mean PTV D95% and D05% endpoints were 0.6±0.5% and 1.4±0.8% lower using the planned dose distributions compared to the recalculated distributions, respectively, across all patients. The mean parotid D50% was 2.4±1.5% greater using the planned distributions compared to the recalculated distributions. The parotid D50% from the planned distributions was also highly correlated with the parotid D50% from the recalculated distributions for each patient (mean r²=0.97±0.09).

Conclusions: For this treatment modality and site, dosimetric differences observed between overlaying the planned dose distributions and recalculating distributions on daily images were typically well within ±5%. This indicates that the dose distribution itself is robust against anatomic variations.

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