Evaluation of Volumetric Change and Dosimetric Discrepancy with Daily Cone-Beam CT for Patients with Head-And-Neck Cancer

In radiotherapy of head-and-neck cancer patients, the actual delivered dose could be quite different from the planned one due to the anatomic changes in both target and organs at risk (OARs). We evaluated the discrepancy between doses in planning and doses of the day due to volumetric change and deformation by using daily CBCT image guidance. Four head-and-neck patients with a total of 150 daily kilo-voltage CBCT scans were selected for this study. All CBCTs of the same patient were rigidly registered with the planning CT based on the bony structures. Contours of the regions of interest were deformed from the planning CT to corresponding CBCT using the MIM deformable registration algorithm (Mimvista, Cleveland, OH). The planning dose matrix was mapped to CBCT images, and doses of the day to the deformed structures were compared with the planned doses.

Figure 1 shows the normalized dose of four individual patients for both targets and critical organs. No significant changes in daily dose coverage of the target were observed. The differences in $D_{95}$ between the dose of the day and planned dose were 0.4 ± 1.2% for the GTV and 1.8 ± 2.4% for the PTV. A slightly larger discrepancy of the target coverage for patient #3 may due to smaller target shrinkage and larger deformation. No significant mean dose variations were found for the spinal cord, mandible and larynx, as expected. The daily mean dose changes for right and left parotid glands were greater than other sensitive structures. And the magnitude of dose variation for parotid has a dependence on where the tumor located (Tumor location: center for patient #1 and 3, right for patient # 2 and left for patient # 4). However, more patient data are necessary to confirm this.

![Figure 1](image)

Figure 1: (a) Normalized $D_{95}$ of the GTV, CTV and PTV. (b) Normalized mean dose for the parotid and larynx. Doses shown are expressed as a ratio to the planned doses for each individual patient.

The coverage of the target did not change significantly despite of tumor shrinkage and anatomic changes. An increase in parotid dose was found. The dose discrepancy can be monitored by daily CBCTs together with deformable registration, and can provide dose guidance for the re-planning.