Dose Accumulation with CBCT Conversion in Head and Neck and Prostate

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Background

- In standard radiotherapy, only one planning CT is used but the size and position of the tumor and organs at risk (OARs) changes during treatment
- Specifically, in head and neck cancers patients lose weight and the parotid glands shrink during treatment and in the prostate the size of the bladder varies fraction-to-fraction (see Figure 1)
- Daily cone beam (CT) is already used in the clinic for patient positioning
- CBCT is easy to acquire via on-board imagers but provides limited field of view and is of poorer quality than CT
- Correcting CBCT via deformable image registration (DIR) enables “dose of the day” calculations

Methods

- Planning CTs, weekly CTs, and daily CBCTs were imported into a commercial treatment planning system (TPS), RayStation (RaySearch Laboratories, Stockholm, Sweden)
- First, rigid registrations were applied. Then, ANACONDA hybrid intensity DIR’s were created. CBCT conversion was performed using the commercial algorithm that uses DIR
- Dose was evaluated in the TPS on all images. Dose on weekly CTs, daily CBCTs, and corrected CBCTs was deformed to the planning CT image. Finally, dose was accumulated on the planning CT and dose differences were qualitatively evaluated

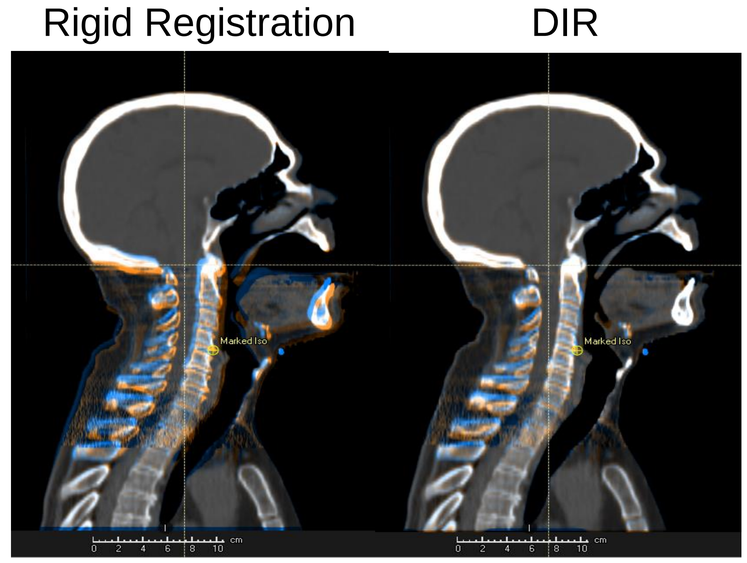

Figure 1. Rigid and deformable image registration performed between planning CT and last day CBCT corrected with primary CT. Image differences are shown in blue and orange. Overlapping areas are in shades of gray.

Results

Figure 2. Right (magenta) and left (blue) parotid glands as seen on CBCT on the first day (day 1) (solid line) and last day (day 33) (dashed line) of treatment.

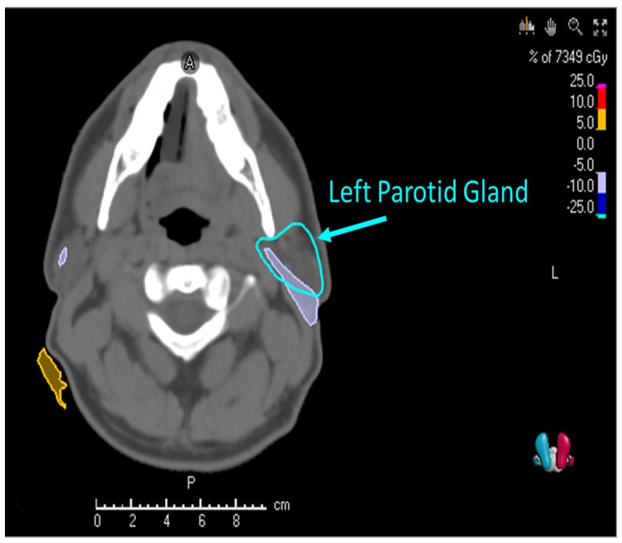

Figure 3. Representative axial dose difference images of a head and neck patient where a dose difference between planning and accumulated with CBCT dose was observed inside an organ at risk.

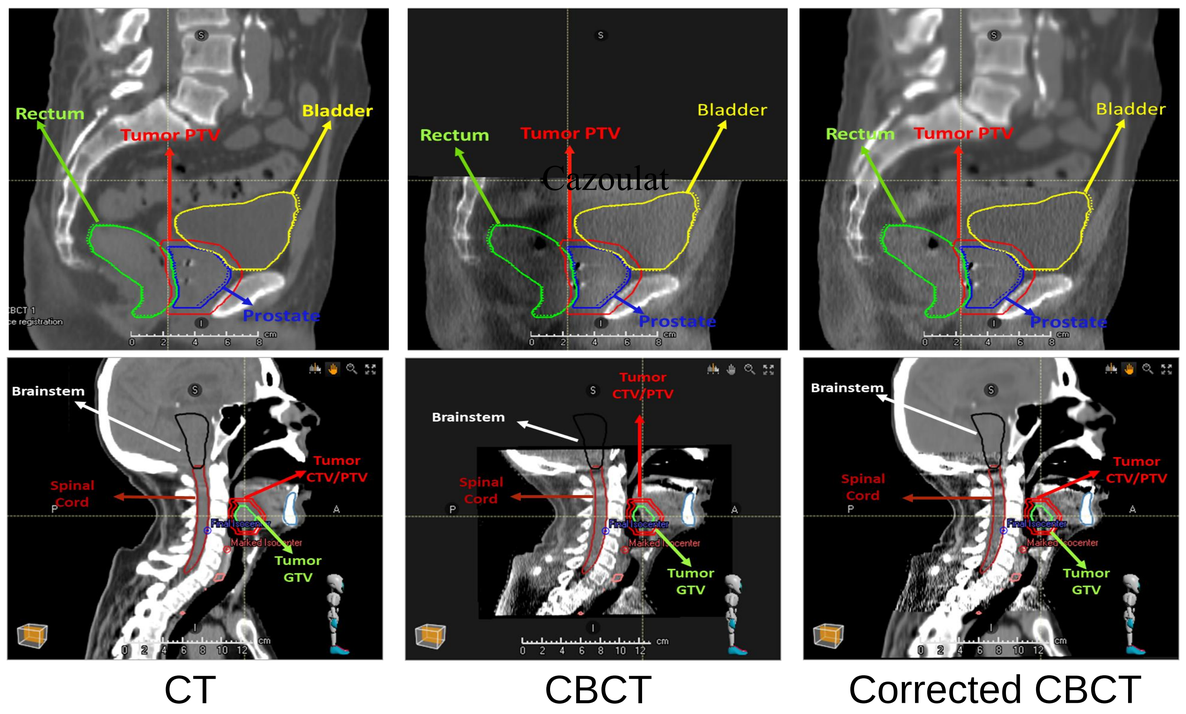

Figure 4. Representative CT, CBCT, and corrected CBCT sagittal images of prostate (top row) and head and neck (bottom row) patients. *GTV: gross target volume, CTV: clinical target volume, PTV: planning target volume.*

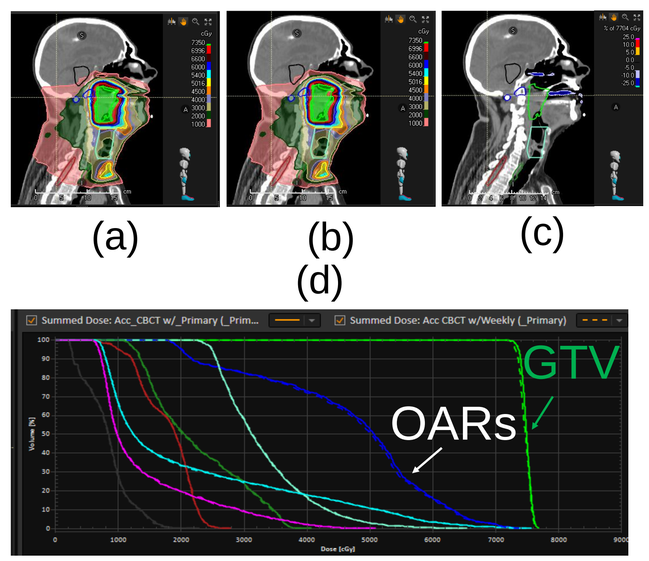

Figure 5. Accumulated dose on CBCTs corrected with primary (a) and weekly CT (b). The dose difference (c) and Dose Volume Histogram (d) are also shown for a representative head and neck patient. *GTV: gross target volume, OARs: Organs at Risk.*

Conclusions

- CBCTs were successfully converted
- Transition areas between the CT and CBCT were smooth
- Dose was calculated on CBCT’s and corrected CBCT’s
- Dose differences were observed between planning CT and accumulated CBCT ; clinical impact is being determined
- No dose differences were observed between CBCT’s corrected with primary and with weekly inside organs at risk

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