Dosimetric impact of CBCT isocenter misalignment on target dose coverage in cranial SRS
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Purpose or Objective: Perfect (zero error) coincidence of CBCT and linac’s isocenters is practically impossible to achieve in clinical practice, due to the presence of several geometric errors in the treatment unit. Our aim is to analyze the dosimetric impact of CBCT isocenter-linac isocenter misalignment on the target dose coverage and tumor control probability (TCP) in cranial SRS plans.

Material and Methods: A Varian Clinac 2100 CD was used. Misalignment of CBCT isocenter with respect to (w.r.t.) radiation linac isocenter was measured during 23 consecutive months. A 5 mm tungsten ball was centered at the room laser isocenter and MV portal images were acquired for four cardinal gantry angles (couch was at zero position). After portal image acquisition, CBCT scan was acquired. All images were analyzed: (a) deviation of the radiation isocenter w.r.t the ball center was measured in each MV image using an in-house code; (b) deviation of the central voxel of the CBCT matrix (CBCT isocenter) w.r.t. the ball center was measured in the Eclipse TPS. Finally, 3D misalignment of the CBCT isocenter w.r.t the linac isocenter was derived from (a) and (b).

To analyze the dosimetric impact of the CBCT isocenter misalignment, 10 cranial SRS cases were randomly selected from our database. For each case, the isocenter in the original plan ("reference plan") was shifted according the misalignments obtained for CBCT isocenter. Eight X-Y-Z shifts generated from "mean ± 1.96 x SD" of the measured CBCT isocenter misalignments were simulated for each SRS plan (i.e., 8 shifted plans) were obtained for each SRS case. Target dose coverage (D99%) and TCP (estimated according to Radiat Oncol. 2015 Mar 8;10:63) were computed for each shifted plan and results were compared to the reference plan ones.

Results: i) Misalignments of CBCT isocenter w.r.t. radiation linac isocenter were (mean ± SD, all in mm): 0.5 ± 0.3; -0.3 ± 0.2 and -0.6 ± 0.3 for X (lateral), Y (anterior-posterior) and Z (inferior-superior) directions, respectively. ii) Target dose coverage (D99%) was degraded from 100% to a mean range of 97%-99% for shifts within 25% variation range. iii) The average loss of TCP was estimated to be about -5% (range: 18% to 0%) among the 80 shifted plans generated in this study.

Conclusion: Our simulations demonstrated that the reduction of target coverage and TCP due to CBCT isocenter misalignment is not clinically significant. Our simulations show clearly the need of add margin to the target to compensate for CBCT isocenter misalignment.

Translational and rotational set-up uncertainties in Head and Neck cancer treatments using CBCT
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Purpose or Objective: The aim of this study was to assess setup errors, both translational and rotational, for head and neck (H&N) cancer patients treated with intensity-modulated radiotherapy (IMRT) and volumetric-modulated arc therapy (VMAT) using daily pretreatment CBCT imaging guidance.

Materials and Methods: A total of 57 CBCTs referred to 7 patients treated with an Elekta Agility Linear Accelerator were analyzed. Patients were treated in a supine position; as immobilization system for head and shoulder a thermoplastic fixation mask was used. Tattoos on the surface mask were placed on the laser projection. Axial CT-planning slices at 5 mm intervals were acquired and reconstructed at 2 mm. Image data set were sent to the Oncentra Masterplan Planning System. Planning CT was also sent via DICOM to XVI software for the co-registration with the CBCT scan. For the CBCT acquisition we used the “fast head and neck 520”. The 3D-3D co-registration with the CT planning scan was performed using the Grey level algorithm. Translations were measured in medio-lateral (x), supero-inferior (y) and antero-posterior (z) directions, as well as in rotation around axes. Online correction for translational displacements were applied, on the basis of literature data, when the discrepancy exceeded 3 mm. Rotation corrections were recorded with a