Computation of the RT dose of the day from mapping CBCT information to the planning CT using an optimized elastic registration method

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Résumé

Purpose: Due to organ motion/deformation, dose distribution from fraction to fraction might be usually different from the intended dose distribution optimized at the planning stage. To evaluate the actual delivered dose in the "patient of the day", we developed a technique of dose computation in the deformed planning CT (pCTD) using an elastic registration from the kilovoltage-CBCT, with an optimized electron density assignment based on a mapping of CBCT information (pCTD,C).

Methods: Dose calculation was performed on successive kilovoltage CBCT (kV-CBCT) for patients treated with conformational or IMRT technique. The linac was a Varian Truebeam (Varian Medical System) equipped with a kV-CBCT system. Patient underwent to the planning CT (pCT) on a Toshiba Aquilon/LB model (Toshiba Medical System) and using Eclipse (Varian MS) for planning the treatment. The geometry of the "patient of the day" was acquired once a week with the same kV-CBCT protocol (half fan, 80kV, 1049mAs). Rigid and elastic registrations of the CBCT to the pCT was made using ISOgray TPS (DOSIsoft S.A., France). The method was first validated using an anthropomorphic thorax phantom (CIRS, Inc., Norfolk, Virginia, USA) with or without added bolus to simulate morphological deformation. A routine was developed using MATLAB2017b to map CBCT information to the pCTD. Dose calculation was performed on the CBCT and pCTD using their respective calibration curve from HUCBCT and HUpCT to electron density.

Results: Dose calculation using an elastic registration method on an anthropomorphic phantom was quantified with a comparison of typical dose calculation computed with the pCTD,C and the CBCT. Dose distributions were in good agreement. Results on patients are pending and would be evaluated in term of dose prescription, PTV coverage and OARs sparing.

Conclusion: We evaluated a dose calculation method based on mapping of CBCT information. The method enable us to efficiently calculate dose distribution with a good accuracy to evaluate the true delivered dose fraction to fraction and to bring out differences from the planning treatment.

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*Intervenant