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PTV and ITV Density Correction in SBRT Lung Planning: A Dosimetric Study for Three Techniques

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Abstract
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Abstract

Objective: To perform a dosimetric evaluation of the density override values on the dose calculated to the ITV and the PTV sub ITV designed (PTV-ITV) in SBRT lung.

Methods: To investigate the dosimetric impact of the density override and it correction, 30 plans are performed for five patients with lung SBRT. Three techniques are used in both average 4DCT planning (CT and CT_Cor with electron correction density).
In most literature, the ITV and the PTVsubITV was affected with various values .In this work we choose respectively an electron density (ED=1, and ED=0.3). All treatment planning was performed on an Average 4DCT,with the TPS Eclipse (Varian Medical Systems, Palo Alto, CA) using the AAA v13.6 (and PO v13.6 for IMRT SW) algorithm with a 2 mm calculation grid size. All these plans are created for delivery on a Varian iX with 120 leaves MLC. All plans use 3D Non coplanar beams (3DNC, 9-11 beams), Dynamic Conformal Arcs (3DCA, one CWor CCW arc in association with two non coplanar half-arcs) and IMRT techniques (7-9 beams). For each technique, every plan was generated in the both type of CT non overridden structure and CT_Cor respectively (with (DCA, 3DNC, IMRT) and (DCA_Cor, 3DNC_Cor,IMRT_Cor). The prescription isodose was 60 %, where the center of PTV is normalized to 100% and as typically 95% of the PTV should receive at least the prescription dose and 99% of the PTV should be covered by at least 90% of the prescribed dose (60 Gy/8Fr).

Results: The conformity index (CN), V20, and the mean lung dose are very statistically improved for all studied especially for the plan 3DNC_Cor. The corrected CT_Cor (15 plans) shows the best gradient index (GI=1.09-1.23). This works demonstrate that there is no statistical significance between all plans uncorrect (ED)CT (CT) and corrected (ED)CT_Cor about OARs dose and targets coverage.
The analysis of these SBRT plans of lung tumor showed that CT_Cor require more monitor units delivery (>1800 MU).

Conclusion: This work demonstrate the importance of the correction of the electron density (ED) using this strategy (subdivision of ITV and PTV-ITV) in planning lung SBRT. This need more investigation and accuracy specially for very small lungs volumes.