A PATIENT-SPECIFIC 3D BOLUS FOR IMPROVING DOSE DISTRIBUTION IN BREAST CANCER RADIOTHERAPY

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External radiotherapy after radically operated breast cancer has been proven to reduce the recurrence of the cancer as well as the mortality. The optimal radiotherapy plan should deliver a uniform radiation dose to the planned target volume while minimizing dose to the surrounding healthy tissue. However, due to usually highly sensitive locations and complexities of the body regions where tumours may be located, this goal needs to be compromised.

Radiotherapy of a radically operated breast is often planned with a combination of electron and photon beams [1]. A gel-filled flat bolus can be applied to the skin to alter the dose received at depth in the tissue but they may cause uneven dose distributions in the target and insufficient protection of lung and heart behind the treatment area.

In our current study, new radiotherapy plans were designed for 6 patients that had already been treated with standard plans, 2Gy during 25 days, up to 50Gy. For each patient a 3D bolus was designed individually based on their 3D CT images around the chest area. Each bolus was designed to optimize the dose coverage of the target by shifting the 85% isodose line of the original radiotherapy plan to follow closely the edges of the planned target volume. New treatment plan including the patient-specific bolus was designed, and compared to the standard plan.

We found that a patient-specific bolus improved the uniformity of the dose in the target area, and decreased significantly the mean radiation dose to the lung (12.0±1.4Gy vs. 10.7±1.9Gy), heart (2.1±0.7Gy vs.1.4±0.4Gy) and left anterior descending artery in the heart (LAD) (11.3±3.7Gy vs. 7.0±1.7Gy). Statistics were tested with a one way RM ANOVA, $P<0.05$.

We conclude that a patient-specific bolus can be used to improve the dose coverage of the radiotherapy and decrease the radiation dose to the healthy tissues. Potentially, a standard 3D printer with a suitable material can be used to produce a patient-specific 3D bolus.

[1] Tenhunen et al. Radiother Oncol. 2009 Oct;93(1):80-6.