USE OF PATIENT-SPECIFIC 3D PRINTED BOLUS IN ELECTRON FIELD RADIOTHERAPY

J-M. Louhelainen, L. Porra, P. Pirhonen and M. Tenhunen

Division of Radiotherapy, Comprehensive Cancer Center, Helsinki University Hospital (HUCH), PO Box 180, FI-00029 HUS Finland
email: jani.louhelainen@hus.fi

Rationale

It is a challenging task to deliver uniform dose to the target volumes of postmastectomy radiotherapy (PMRT) for node positive breast cancer. We present a new 3D printing method of creating a patient-specific bolus, which can be used in electron-photon PMRT to optimize the distribution of dose in planned target volume (PTV) and to protect organs at risk (OAR).

Materials and methods

The study involved eleven randomly chosen postmastectomy patients. New plans with patient-specific boluses were created and compared to the original plans. The relative volumes of several dose values were calculated from the cumulative DVHs of the PTV and OAR structures. Our method was to 3D print a separate rigid mould (shell) and to fill it with silicone material thus forming the actual bolus. The silicone was verified dosimetrically by comparing the measured PDD curves to eMC calculations for 6, 9 and 12 MeV electron fields.

Results and conclusions

The comparison of PDD curves resulted a good correlation with bolus density HU = 0. The treatment plan comparison showed that doses of OARs reduced significantly with 3D bolus. A minor increase in PTV D(V=1%) (Gy) of 0.6 ± 0.8 ($p=0.022$) was noticed when the 3D bolus was added. For the lung, using the 3D bolus produced V(20 Gy) = 21.7 ± 4.9% versus V(20 Gy) = 26.7 ± 3.6% of the original plan ($p=0.008$). For the heart, V(5 Gy) is 4.3 ± 2.8% with the 3D bolus, whereas without it was 7.3 ± 3.1% ($p=0.008$). The LAD was significantly better protected with the 3D bolus, reducing the dose from V(10 Gy) = 71.4 ± 34.7% to only V(10 Gy) = 38.8 ± 36.6% ($p=0.003$).

The 3D printed patient-specific bolus reduces significantly dose to lung and heart in PMRT.