Evaluation of superficial doses for postmastectomy radiotherapy

Introduction: For patients undergoing postmastectomy radiotherapy (PMRT), irradiation with a high energy photon beam usually presents a high dosimetric uncertainty region at the thin tissue layer for both dose calculation and dose measurement. Assessments for skin and superficial doses are difficult in this area. In regards to whether a bolus in PMRT is needed or not, the chest wall dose distributions in PMRT should be evaluated well.

Methods: In order to assess superficial doses for chest wall treatment (6 MV photons), treatment plans of 2-tangential wedged fields (TWF) and 4-field IMRT were designed on five simulated chest wall geometries with chest wall thicknesses of 5, 8, 10, 13 and 15 mm (Fig. 1) using an Eclipse treatment planning system. In addition to dose calculations, EBT films were placed on the phantom surface to measure doses at depths of 0, 1, 2, 3, and 5 mm for each treatment technique and each chest wall thickness.

Results: For the TWF plans, the mean surface doses at the incident point of PTV are 91.4 cGy (51% of the prescribed dose (Dp)). Plans of 4-F IMRT show a more uniform dose distribution than TWF plans within the PTV region. The mean surface dose within the PTV is 116.4 cGy (65% of Dp). The doses for 4-F IMRT plans increase more significantly with depth than the TWF plans. The dose profile of 5 mm chest wall thickness of 5 mm depth shows a dose lower than the Dp at the median incidence position and with significantly lower doses than the dose profiles of 2 and 3 mm depths (Fig. 2).

Discussion and conclusions: For the TWF plans, the doses increase with the angle of incidence and the increases are insignificant for depths larger than 3 mm. This means that for a TWF plan the minimum dose for each scenario is at the surface of beam entry position and the dose increases gradually to the maximum at the most obliquely tangential angle. The dose variations caused by the oblique incidence and a thin chest wall are modulated and reduced in the IMRT plans.

For patients who underwent PMRT, based on the results of this study, a bolus with thickness larger than 3 mm is necessary to ensure the PTV is treated with an adequate dose when the TWF technique is used. Owing to the shallower dose buildup in the 4-F IMRT plan, a bolus thicker than 2 mm is enough to give doses higher than Dp to the PTV.