

X-ray Scattering Effect on the Heterogeneous Dose Distribution in a Cell Box

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The oxygen enhancement ratio (OER) is very important factor in radiotherapy since none produces such a dramatic effect and no other agent has such obvious practical implication. Although it is usually assumed that the dose distribution in a cell box for OER measurement is uniform, the absorbed dose to the tumor cells could be very different according to the locations of the cells within a cell box, which affects the cell survival curves. In this study, we have investigated the dose distribution in a cell box. Three different sizes of cubical cell boxes, whose side lengths are 10, 15, 20 cm, were designed and irradiated by 6 and 15 MV x-rays. The differences of the absorbed doses at the center between 10x10x10 cm³ box and 20x20x20 cm³ box were less than 2 % for 6 MV and 15 MV x-ray irradiation, which indicates that the scattering effect depending on the size of cell box is not significant. However, the relative dose distribution within the cell box shows very different behavior revealing distinct heterogeneous dose distribution in a cell box. The results show that the percentage showing more than 10 % dose difference within the cell box was ~ 40 % for 20x20x20 cm³ box with 15 MV x-ray irradiation. While the dose inhomogeneity for 15 MV x-ray irradiation increases as the size of cell box increases, the dose inhomogeneity for 6 MV x-ray doesn't show any size dependency. Our experimental evidence suggests that the dose inhomogeneity within the cell box, which is mainly caused by the scattering of x-ray, is not negligible and the location of the cells in the box is carefully designed since the survival curve could be very different.

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