3 - 42 Fast Calibration of EBT Films in Scanned Ion Therapy

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In the quality assurance of photon and ion beam radiotherapy with EBT films, the dose response curves of these films should previously be calibrated. The traditional calibration method is to cut a big piece of EBT film into many small ones, which are separately irradiated with different doses. Then these small EBT films are digitized with a commercial flatbed color scanner to get the net optical density (netOD) values, which are fitted against the doses. In this work, we present a fast calibration method of EBT films in scanned ion radiotherapy.

The dose distributions of irradiation fields are always deduced from the irradiated films together with the dose response curve, whereas, it is rare to get the dose response curve of films from exactly known dose distributions. For fast calibration of EBT films, we used an exactly known Gaussian-shaped dose distribution of carbon ions to deduce the dose response curve. In order to obtain the Gaussian parameters of the dose distribution, the calibration factor (CF) defined as a number of particles per monitor unit (MU) and the beam profile (BP) were measured respectively. The CF was measured with the method described by Jakel et al[1]. A thick collimator with a circular hole was inserted in the upstream beam line to get an exactly Gaussian-shaped dose distribution which was measured with a multi wire proportional chamber (MWPC). Then, the dose response curve of EBT films was derived from the netOD distribution and the dose distribution modeled with the parameters of MUs, CF, BP and mass stopping power.

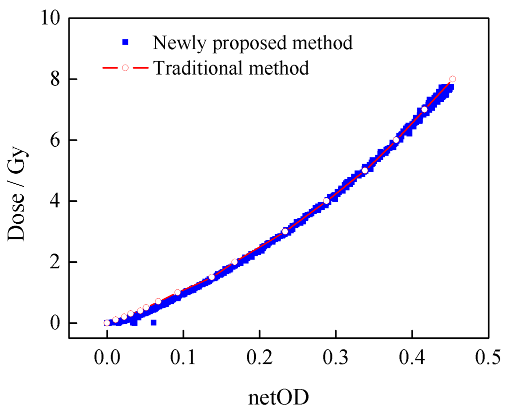

Fig. 1 (color online) The dose response curve.

The dose response curve obtained using this new method was compared with the one acquired using the traditional method (shown in Fig. 1). Our results show that the two curves matched well in the high dose region above about 13% of the highest dose and the former curve prone to higher netOD values in the low dose region. This could be ascribed to the single Gaussian parameterization of the dose distribution.

Using the proposed method, a dose response curve of EBT films comparable with the one obtained from the conventional approach can be acquired if two or more pieces of films are irradiated with laterally Gaussian shaped beams of proper MUs.

Reference

[1] O. Jakel, G. H. Hartmann, C. P. Karger, et al., Medical Physics, 31(2004)1009.

3 - 43 Efficiency of the Respiratory-gated Irradiation in Heavy Ion Radiotherapy

He Pengbo and Li Qiang

For the conventional free breathing (FB) based respiratory-gated pulsed heavy-ion irradiation, three parameters such as respiratory start phase, magnet excitation cycle (MEC) and duty cycle (DC) may affect the final treatment efficiency[1]. In the present study, the effect of start phase correlation between respiration and synchrotron magnet excitation was simulated for four initial respiratory phase values: $\pi/2$, π, $3\pi/2$ and 2π. The effects of synchrotron MEC for respiratory-gated irradiation were examined with various MEC settings of 4.2, 5.2, 6.2, 7.2, 8.2, 9.2, 10.2, 11.2, 12.2, and 13.2 s. The DC values for respiratory-gated irradiation were set to 10%, 20%, 30%, 40%, and 50% around the peak exhalation phase of the respiratory cycle for each volunteer's respiratory motion data.

Fig. 1 illustrates the distribution of effective dose rate (EDR) of FB-based gating, depending on various MEC and DC settings, based on 3 000 statistical data points that were obtained from 15 volunteers; the error bars show