

Deconvolution of Detector Size Effect for Output Factor Measurement of 4 mm Collimator in Gamma Knife

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We investigate the effect of detector size for output factor measurement of small field in Gamma Knife. Measured and corrected output factor using deconvolution to remove the effect of detector size for the 4 mm collimator is compared. The output factors were measured with a pinpoint ionization chamber, a glass rod detector (GRD) and gafchromic films from the 14, 8 and 4 mm helmets relative to the 18 mm helmet. The measured output factors were corrected for spatial averaging effects by measuring dose profiles for the 4 mm collimator with the same detectors and deconvolving their response from the measured profiles. A Gaussian kernel was used to describe the detector response. The measuring volume of pinpoint chamber was 0.015 cm³ and the size of the GRD was 1.5 mm in diameter and 8.5 mm in length. All measurements were performed in spherical polystyrene head phantom made two half spheres, having a diameter of 160 mm. The relative output factor for the 4 mm collimator measured by the ion chamber was 0.769 ± 0.009 and the GRD measurement was 0.869 ± 0.011 . The gafchromic film measured value was 0.845 ± 0.018 . The corrected output factor by deconvolving for the 4 mm collimator was 0.856 ± 0.015 for the ion chamber and 0.873 ± 0.015 for the GRD, 0.871 ± 0.015 for the gafchromic film. The measured value of the 4 mm collimator output factor from the ion chamber was significantly lower than the results obtained using other detectors. Due to the large volume of pinpoint chamber compared to other detectors used, a significant deconvolution correction was noted for the for the smaller helmet size. The difference for measured and corrected value of output factor based on GRD detector was within 0.5%. The GRD may be a useful detector for small field dosimetry.

Keywords : Deconvolution, Gamma Knife, Detector Size Effect