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Comparison of Various Detectors by Dosimetric Factors in Irradiated Small Field

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Purpose ; The aim of this study is to evaluate small beam dosimetric parameters such as percentage depth dose, dose profiles at the different depths and output factors, and to analyze the dependency of detectors in the small beam dosimetry. Methods and Materials ; Small beamlets in the intensity modulated radiation therapy (IMRT) or surgery (IMRS) are very commonly used to optimize the desired dose distributions. A standard dosimeter like a mid-size ionization chamber (0.1~0.2 cc) for the usual beam data acquisition artificially broadens the penumbra region due to volume effects and makes errors of the output factors caused by electronic dis-equilibrium. Depth dose is also depending on the resolution of detector for measurement. This error source specifically leads the inaccuracy in dose calculation of IMRT or IMRS using complex dose segments 2,×1, 2×including many small beamlets. The evaluated small beam fields are 1 4 cm2 collimated fields, not including multileaf collimated small beam×3, 4×3 with rounded leaf end and inter-, intra-leaf leakage effects. The PDDs were measured under source to surface distance (SSD) 100 cm for each small beam fields. PDDs were evaluated by the ratio of PDD20/PDD10 (IAEA TRS-398 protocol). The dose profiles were measured at dmax (1.5 cm for 6 MV), 5 cm, 10 cm, and analyzed at the levels of 90%, 80%, 50%, 20%. Full width half maximum (FWHM), effective treatment region field ratio (ETR ratio), which is defined by (90%/FWHM) width, penumbra width (80%~20% distance) according to the various depths (1.5 cm, 5 cm, 10 cm). The output factors were measured at the depth of 1.5 cm water under SSD 100 cm with 4 small fields and 3 different detectors above. Results ; In the results of PDD, PDD10 and PDD20 for all of the small fields showed good agreements within maximum 3% with three detectors. The ratio PDD20/PDD10 for beam quality variation showed that there was not much dependency 1 cm2 were shown largest differences×of the type of detectors. ETR ratios of 1 (max. 55%) among the detectors. ETR ratios has shown the bigger according to the resolution of detectors and decreased by increasing measured depths and field sizes. Conlusion ; This study has shown that the commissioning of small beam with high resolved detectors could give more accurate measurements and it could improve the reliability of the treatment planning. In the future, it is highly probable that very high resolved detector such as stereotactic field detector (SFD) will be widely used for commissioning of small beam fields of IMRS or high multi-segmented IMRT.

Keywords : Small Field, FWHM, Beam Factor