

Analysis of dosimetric characteristics of flattening filter free photon beams and comparison with regular beams

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Purpose: Flattening Filter Free (FFF) photon beams have recently become available on some modern linear accelerators in radiation therapy with high dose rate, but for the use of this beam type, the accuracy of basic dosimetric data acquisition is important because it is directly related to the dose given to patients.

This study aimed to analyze the dosimetric data of the FFF photon beams, as compared to the standard photon beams.

Methods: Basic dosimetric properties of 6 MV and 10 MV photon beams from a linear accelerator operating without the flattening filter have been analyzed. These include dose rate data, depth dose dependencies, lateral profiles and output factor in a water phantom and transmission factors of a multi-leaf collimator. The data are compared with dosimetric data for the flattened beams (FB).

Results: The FFF beams have the following : a higher dose rate by factors of 2.3 (6 MV) and 4 (10 MV), the maximum dose is closer to the surface (varies less with field size and is deeper for largest field sizes), beam quality is lower (5% for 6X FFF & 4% for 10X FFF), surface dose is higher and flatness is similar for small field sizes, decreased penumbra, lower out-of-field dose (around 1.7 % for 10X FFF), smaller output in air variation with the field sizes, leaf transmission is lower (0.2% for both energy), less head scatter and no beam hardening in central region of the beam (lower mean energy, uniform energy spectra along the field).

Conclusions: This study provided us valuable information on the characteristics of the FFF beams, its variation with respect to FB and its consistency. The findings suggest that with a flattening filter free accelerator better radiation treatments can be developed, with shorter delivery times and lower doses to normal tissues and organs.

Keywords: flattened beams (FB), Flattening Filter Free (FFF), high dose rate.