

Purpose: Recently, there has been an increasing interest in flattening filter free (FFF) X-rays, which offers far more efficient photon utilization and significant increase in dose rate at the treatment target. The FFF mode is especially beneficial for stereotactic radiosurgery (SRS) and stereotactic body radiotherapy (SBRT). However, the skin dose of the FFF X-rays remains a concern. Here, skin dose of the FFF X-ray photons is measured using a parallel-plate ionization chamber and evaluated by comparing to the conventional flattened X-ray photons.

Methods: A Varian's TrueBeam linac with 6MV and 10MV FFF and flattened X-ray photons has been in full clinical operations since July 2010. Entrance dose was measured using a parallel plate ionization chamber and solid water phantom with buildup depth = 0, 1, 2, 4, 5, 7, 10, 15, 20 and 25 mm. Different field size (FS) patterns were created in Eclipse Treatment Planning System by MLC rather than jaws (FS=2, 3, 4, 6, 10cm by MLC and jaw size=2.2, 3.2, 4.2, 6 and 10cm). It is worth noticing that FS was much bigger than the ion chamber and FS formed by MLC was clinically more meaningful than jaws. All radiation measurements were normalized to the 10x10 field at dmax.

Results: Good repeatability of the measurement was demonstrated and dose linearity was shown in both flattened and FFF 6X and 10X photons. Moreover, skin dose of the FFF photons was modestly larger than that of the flattened photons for both 6X and 10X at different buildup depth for different FS (2-10cm). The difference was not substantial (e.g.: 6X flat vs. FFF at surface: 27% vs. 33%; 10X flat vs. FFF at surface: 20% vs. 24%).

Conclusions: The FFF photons have higher skin dose than the corresponding flattened X-ray. However, the difference is not substantial.