Detector specific output correction factors in small fields for 2D detector arrays

E. Gershkevitsh[1], I. Mendez[2], B Casar[2]
[1] North Estonia Medical Centre, Tallinn, Estonia
[2] Institute of Oncology, Ljubljana, Slovenia

Background

IAEA TRS-483 has greatly improved the methodology of small field dosimetry of megavoltage photon beams by introducing and providing detector specific output correction (DSOC) factors for many different detector types. However, TRS-483 does not contain DSOC factors for 2D detector arrays designed for measurements in small fields. The purpose of this study was to determine DSOC factors for five different commercially available 2D detector arrays using W1 scintillator (Standard Imaging, WI, USA) and EBT3 Gafchromic (Ashland, NJ, USA) films as reference detectors

Material & Methods

Five different 2D detector arrays (IBA Matrixx Resolution, IBA MyQA SRS, PTW Octavius 1600 SRS, PTW Octavius 1500 and SunNuclear SRS MapCheck) were studied. The arrays were sandwiched between Virtual water (Med-Cal Inc., WI) slabs positioning the effective point of measurements at 10 cm depth, SSD=90 cm. 7 cm slabs were placed below the detector arrays for backscatter. The detector arrays were irradiated on TrueBeam linear accelerator equipped with stereotactic conical collimators (ø 4, 5, 7.5, 10, 12.5, 15, 17.5 mm) with 6 WFF, 6 FFF and 10 FFF beams. The measured output factors were compared to the relevant reference values obtained in water phantom with W1 scintillator and in Virtual water with EBT3 Gafchromic films for the same set-up as it was used for 2D detector arrays.

Results

Some of the detectors exhibited pronounced dose-rate effect., therefore it was decided to separate the dose-rate effect from DSOC caused by volume averaging and perturbation. DSOC factors were within ±3% for most of the studied detector arrays, for the cone size 12.5 mm and above. Largest DSOC factors were found for the smallest cone sizes. However, PTW Octavius 1500 array had a correction factor higher than 5% even for the largest 17.5 mm cone. The highest congruence with output factors obtained with reference detectors showed IBA MyQA SRS 2D detector array having DSOC factors within 2% for all cone sizes.

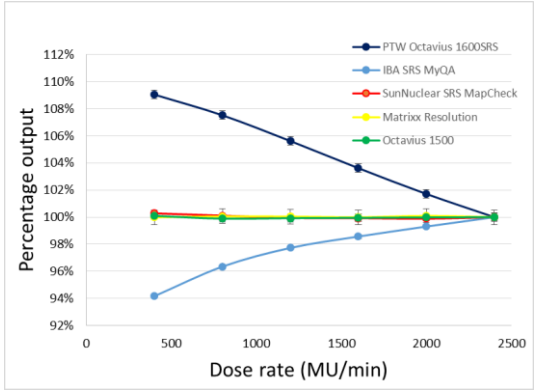

Figure 1. Dose-rate effect for different detectors (shown for 10FFF beam with 2 SD). It has a similar shape, but smaller magnitude for 6WFF and 6FFF

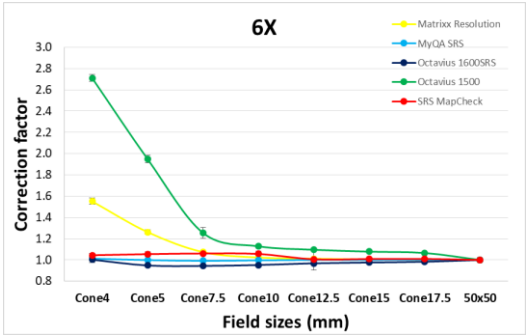

Figure 2. DSOC for 6WFF beam (with 2 SD)

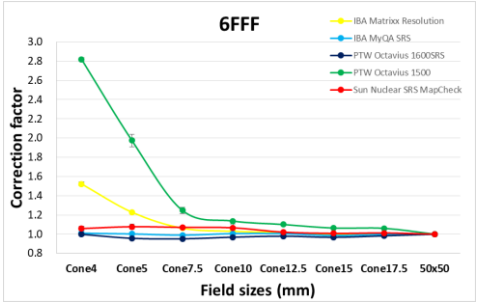

Figure 3. DSOC for 6FFF beam (with 2 SD)

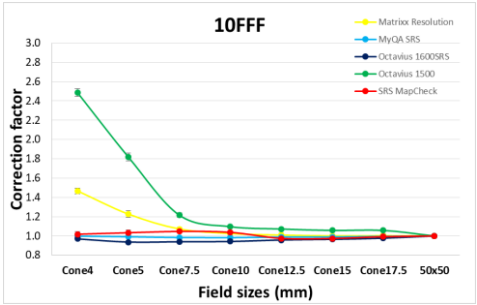

Figure 4. DSOC for 10FFF beam (with 2 SD)

Conclusion

The detector specific output correction factors were determined for five commercially available 2D detector arrays. They can be used to correct the readings for output factors in small fields. Some of the arrays exhibit dose-rate dependence which need to be accounted for when there is a difference between calibration and measurement field sizes due to change of output/ dose-rate.