# Evaluation of IAEA small field correction factors using different detectors for FF and FFF energies

Gloria P. Beyer[1], Ghirmay Kidane[2], Raquel Paiva[1], Vasu Ganesan[2] , Liz Crees[2]

[1]MPSi Medical Physics Services International Ltd., Cork, Ireland

[2]Radiotherapy Department, Queen's Hospital, Romford, UK

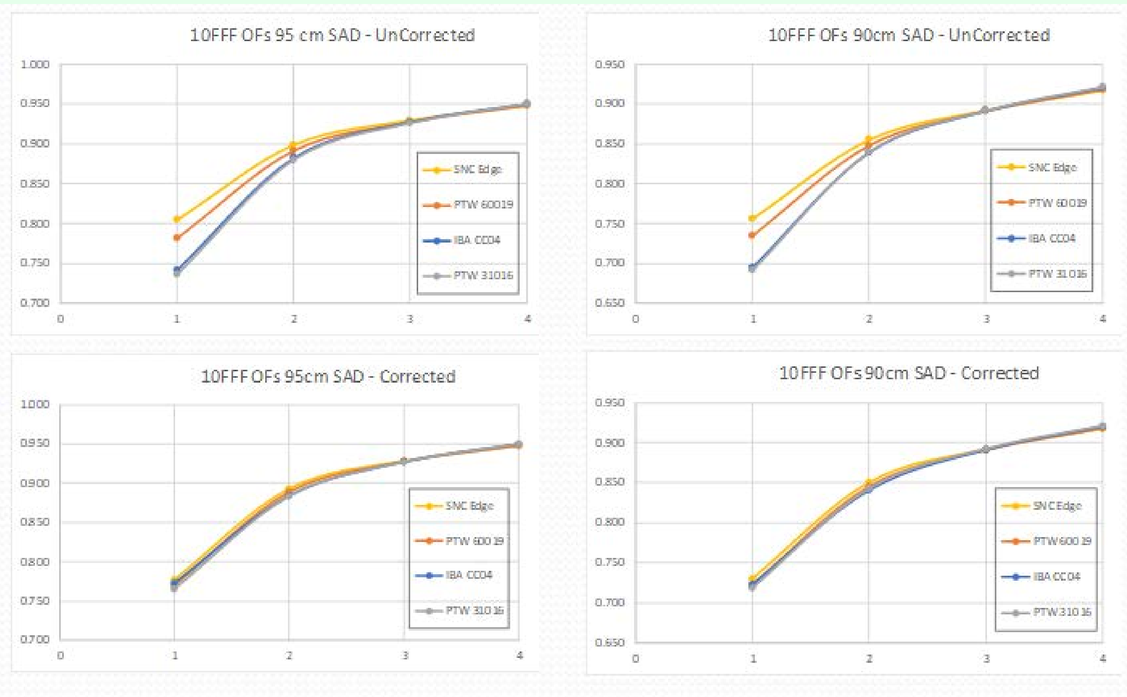
## OBJECTIVES

Small field dose measurements require correction factors due to variations in their dosimetric characteristics affecting the detector response. The IAEA TRS-483 report has tables of small field correction factors for different detectors. These correction factors are specified for a reference depth, and depend on machine type, energy, and field size at measured depth. This work evaluates the variability of readings obtained using various detectors when these correction factors are applied, the suitability of the correction factors for depths other than the specified depth, and the validation of a simple method to estimate or validate the correction factors of newer detectors not included in the protocol.

## METHODS

Output factors were measured using an isocentric setup for depths of 10 and 5 cm for four small MLC defined fields. Measurements were performed on a Varian Edge with HDMLC for 6X, 6FFF, and 10FFF. Though the published IAEA linac correction factors are specified for use at 10 cm depth, the protocol indicates that data obtained at 5 cm depth was used to determine the factors for detectors not showing field size dependence above 3 cm. The four detectors used in this study (IBA CC04, PTW 60019 microdiamond, PTW 31016 PinPoint, and SNC Edge) have existing IAEA protocol correction factors and do not show this field size dependence. Therefore, the correction factors were applied to measurements performed at 10 cm and 5 cm. Two newer detectors used in the measurements (IBA RAZOR and IBA RAZOR Nano chambers) did not have IAEA correction factors. The average corrected readings of the four detectors were used to calculate approximate correction factors for these new detectors.

Fig. 1 Comparison of detector response for 10FFF energy with and without IAEA small field correction factors applied for two different




## RESULTS

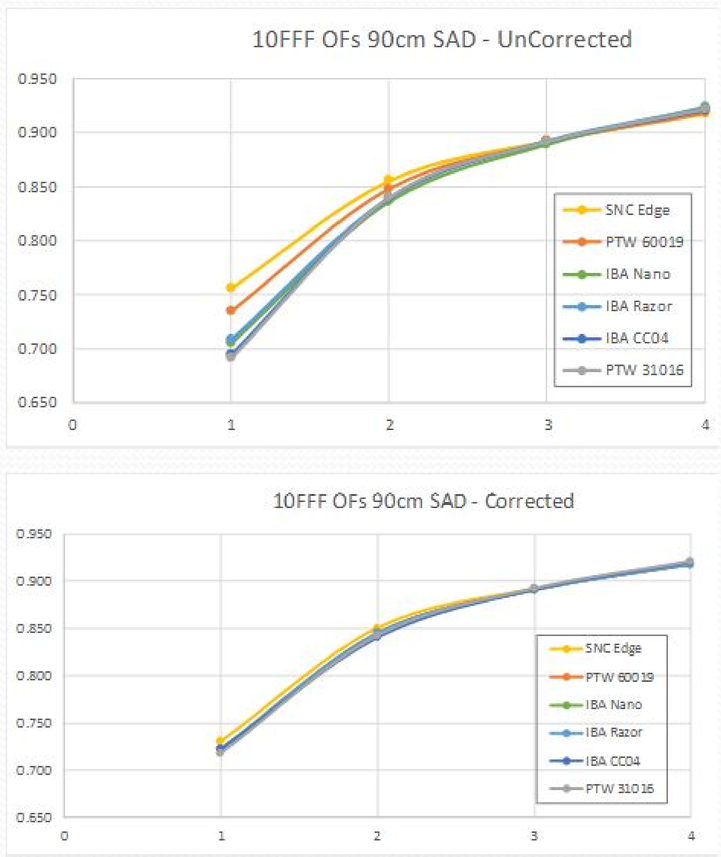
The application of the IAEA small field correction factors reduced the variability of the output factor measurements. The factors applied to 1x1 $cm^2$ field reduced the variability within measurements to <1% for all energies. Specifically, the reductions were from 2.1% to 0.3%, 1.9% to 0.9%, and 3.2% to 0.5% for 6X, 6FFF, and 10FFF, respectively. The correction factors for 6FFF did not reduce the variability as much as for the other energies. The reduction in variability was found to be the same for factors measured at depths of 5 cm and 10 cm; thus, confirming the applicability of the correction factors for depth of 5 cm for energy independent detectors (Fig. 1). The corrected measurements for the detectors included in the protocol can be used to determine an approximate correction factor in line with the IAEA protocol or to evaluate other published factors for newer detectors which are not included in the protocol tables (Fig.2).

Fig. 2 Variability of output factor measurements for 10FFF (d=10 cm, SSD 90cm) before and after applying correction factor and the use of average readings of detectors with IAEA correction factors to estimate or validate clinical correction factor for new detectors not included in the protocol.

| Uncorrected OFs - 10FFF | | |
|---|---|---|
| CC04, Mdiam, PinPt, Edge | | |
| Field Size | AVE | ST DEV |
| 4x4 | 0.919 | 0.2% |
| 3x3 | 0.892 | 0.1% |
| 2x2 | 0.846 | 0.8% |
| 1x1 | 0.719 | 3.2% |

| Corrected OFs - 10FFF | | |
|---|---|---|
| CC04, Mdiam, PinPt, Edge | | |
| Field Size | AVE | ST DEV |
| 4x4 | 0.919 | 0.2% |
| 3x3 | 0.892 | 0.1% |
| 2x2 | 0.845 | 0.4% |
| 1x1 | 0.724 | 0.5% |

| DERIVED CORR. FACTORS | | |
|---|---|---|
| 10FFF | IBA Razor | IBA Nano |
| 4x4 | 0.997 | 0.996 |
| 3x3 | 1.000 | 1.003 |
| 2x2 | 1.007 | 1.011 |
| 1x1 | 1.021 | 1.026 |




## CONCLUSIONS

The IAEA TRS-483 protocol provides a method to standardise the small field measurements and minimise variability between the response of different detectors. The correction factors can also be applied for measurements at 5 cm depth for energy independent detectors. Detectors included in the protocol can be used to validate or to estimate correction factors for small field measurements with new detectors.



Email: gpbeyer@MedicalPhysicsServices.com