Measurement of Output and PDD for SRS Cones with Semiconductor and Microdiamond Detectors

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INTRODUCTION

For practical SRS commissioning it is essential to precisely measure output factors of small SRS cones. A recent joint workgroup of AAPM- IAEA publication[1] calculates correction factors for each particular detector and cone. Use of these factors significantly improves agreement between different detectors and slightly changes the output measured, as demonstrated by our measurements in Fig. 1.

It is also very important to accurately measure PDD of narrow fields, as the detector can "walk away" from the beam center with increasing depth if the scanning line does not coincide with the beam axis. We came up with a simple practical method presented below.

AIM

Accurate measurement of output factors of small SRS cones using two independent detectors with corrections from an IAEA report #483.

Measurement of PDD for small SRS cones using several parallel auxiliary scans with a diode in a scanning water tank.

METHOD

For cone output measurements, we used a PTW microdiamond detector and Sun Nuclear "Edge" diode. New correction factors were from the AAPM-IAEA joint working group. A scanning IBA water tank Blue Phantom allowed optimum positioning of the microdiamond diode detector to maximize the dose reading in a 1D water tank Norgren from IBA, using the light field guidance and small table adjustments.

PDDs were measured using Edge diode in a scanning water tank. For small cone sizes, it is imperative that the scanning direction is parallel to the cone axis. To verify that, we performed four additional parallel scans, surrounding the main one with the distance of 1 mm from the beam axis (see BEV in Fig.2). We used small distances between the scans to prevent the detector at depth to unnoticeably deviate from the beam axis due to misalignment. If all of the peripheral scans measured PDD curves lying lower than the main scan curve, the latter was considered validated.

RESULTS

Use of the new correction factors allowed to reduce the discrepancy between the output factors measured by the two detectors from 1%-6% to 0.4%-1.2% (depending on the cone size) and changed the output factor measured by the diode by 1%-5%.

For the PDD measurements, all the peripheral PDD curves were lying below the main curve thus validating the measurement.

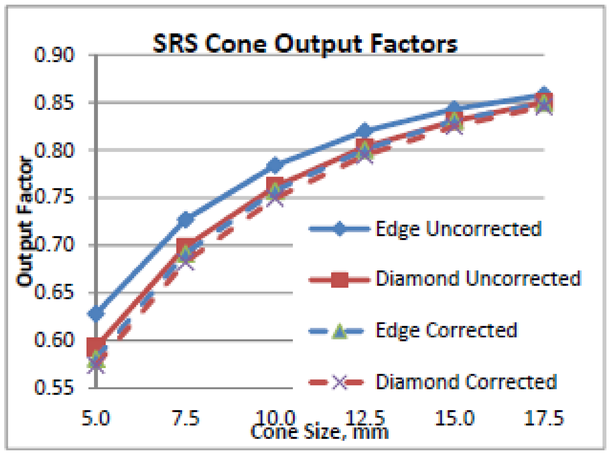

Fig. 1. Improved agreement between different detectors with the use of corrections from publication.[1]

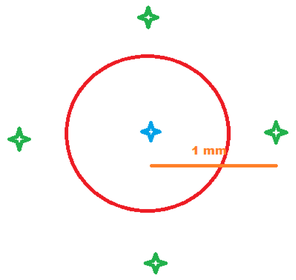

Fig. 2. BEV of the scanning plane. Red circle is the central portion of the beam. Its diameter is smaller than the cone size. Blue asterisk is the axis of the main scan. Green asterisks denote the axes of surrounding scans , each is 1 mm away. If the PDD of the main scan is higher than the other 4, than the main scan is considered valid (see Fig. 3).

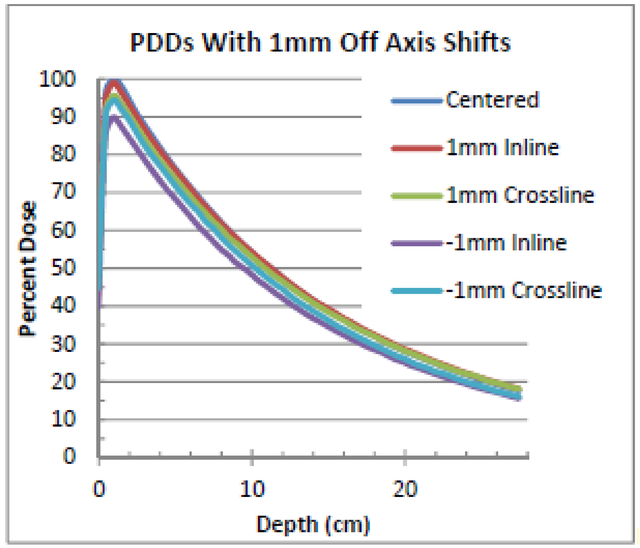

Fig. 3. PDD curves of the central and peripheral scans, as shown in Fig. 2. The dark blue curve of the central scan is just slightly higher than red curve for the vertical scan shifted by 1 mm in inline direction. Other scans result in PDD curves also lower than the dark blue.

CONCLUSIONS

The practical methods described can be used for commissioning an SRS system with small cones.

New correction factors significantly improve agreement between different detectors. Using the corrections published in[1], the acceptable agreement has been achieved for all cone sizes larger than 4 mm (Fig. 1)

Measurement of PDD for small SRS cones using a diode in a scanning water tank is usually challenging because of possible misalignment between the cone and the scanning axis, resulting in the detector leaving the radiation area with depth. To validate the main scan along the cone axis, we performed four additional parallel scans, surrounding the main one with the distance of 1 mm from the cone axis (Fig. 2). The distance between the scans (green asterisks) was chosen small enough to prevent the red circle to "escape" between the green asterisks with increased depth due to possible direction misalignment. If all the peripheral scans measured smaller PDD than the main scan, the latter was considered validated (Fig. 3). If one of peripheral scan PDD curves becomes slightly higher than the curve of the main scan, sometimes it is possible to construct the corrected PDD curve combining both measurements.

REFERENCES

[1] "Dosimetry of Small Static Fields Used in External Beam Radiotherapy". IAEA report #483, 2017

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