AbstractID: 10716 Title: Full Monte Carlo computation of k correction factors calculated in Tomotherapy static and helical deliveries for future ion chamber reference dosimetry protocols of non standard beams

Purpose: Calculate correction factors for ion chamber dosimetry using Monte Carlo (MC) simulations for future IAEA/AAPM protocols adapted to Tomotherapy treatments.

Material and methods: The formalism in Alfonso *et al* (Med. Phys. **35** 2008) introduced two corrections factors: $k_{Q_{MSR}}^{f_{MSR}}$ defined for a "machine-specific-reference" field f_{MSR} (10x5 cm² field, source-surface distance of 85 cm) and $k_{Q_{PCSR}}^{f_{PCSR}}$ for a "plan-class-specific-reference" field, f_{PCSR}, closer to actual clinical treatments. Here, f_{PCSR} was a helical sequence delivering a centered cylindrical homogeneous dose over 10 cm in a homogeneous cylindrical phantom. The *k* factors were calculated using MC with accurate simulation of static and helical deliveries (using TomoPen, based on PENELOPE) and detailed modeling of the geometry of the ion chambers Exradin A1SL, PTW-30013, Wellhöfer IC-70 and NE-2571. Calculations in the phantoms were performed by the "cavity" EGS++ user code, for static beams, and PENELOPE for both helical and static beams. Correction factors were calculated from the formulas $k_{Q_{MSR},Q_{Co}}^{f_{MSR},f_0} = \frac{(D_m/\overline{D_a})_{Q_{MSR}}^{f_{MSR}}}{(D_m/\overline{D_a})_{Q_{Co}}^{f_{Co}}}$ and $k_{Q_{PCSR},Q_{Co}}^{f_{PCSR},f_0} = \frac{(D_m/\overline{D_a})_{Q_{PCSR}}^{f_{PCSR}}}{(D_m/\overline{D_a})_{Q_{Co}}^{f_{Co}}}$ where D_m is the dose at the reference point in medium *m* (water or Solid Water$^{\mathrm{TM}}$) and $\overline{D_a}$ is the dose averaged over the air cavity.

Results: For the A1SL chamber, $k_{Q_{MSR},Q_{Co}}^{f_{MSR},f_0}$ equaled 0.997±0.001 (3σ), which is consistent with the values previously reported using existing protocols. $k_{Q_{PCSR},Q_{Co}}^{f_{PCSR},f_0}$ was estimated at 0.995±0.002 for the procedure chosen. The work is in progress for the ion chambers listed above and other Tomotherapy "*PCSR*" settings, like a typical bilateral head and neck treatment delivery planned on a phantom.

Conclusions: A powerful MC method is proposed here to compute accurate correction factors for Tomotherapy treatments. The data obtained may be of primary importance during the final definition of a new dosimetry protocol, adapted to nonstandard treatments like Tomotherapy and may also improve global treatment accuracy, especially for helical deliveries.

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