AbstractID: 12898 Title: Advanced dosimetry techniques for accurate dose measurement of small and nonstandard fields

Purpose: To establish reference dosimetry techniques for accurate dose measurement of small and nonstandard fields and application to nonstandard field deliveries.

Methods and Materials: A cylindrical PMMA phantom filled with water was constructed in the center of which reference absorbed dose to water was measured. Two candidate plan-class specific reference (pcsr) fields for (i) linac-based and (ii) TomoTherapy®-based typical head and neck IMRT deliveries were created on the CT images of the phantom. The absorbed dose in each pcsr field normalized to that in a 10×10 cm^2 was measured using four reference detectors: Gafchromic® EBT films, a diamond detector, and an in-house developed guarded liquid ionization chamber (GLIC-03) for the linac-based IMRT delivery and a PTW microLion chamber for the TomoTherapy®-based IMRT delivery. Based on the new dosimetry formalism, pcsr correction factors $k_{Q_{pcsr},Q}^{f_{pcsr},f_{ref}}$ were determined for five air-filled ionization chambers: Exradin A12, NE2571, Exradin A1SL, Exradin A14, and PinPoint® 31006. The correction factor measurements were carried out in fully-rotated and collapsed deliveries for the linac-based IMRT delivery and only in a fully-rotated delivery for the TomoTherapy®-based IMRT delivery.

Results: For the linac-based IMRT delivery, the evaluated overall uncertainty in measuring $k_{Q_{pcsr},Q}^{f_{pcsr},f_{ref}}$ was 0.3 %. The $k_{Q_{pcsr},Q}^{f_{pcsr},f_{ref}}$ is chamber independent within uncertainty (0.9955-0.9986) and systematically smaller than unity in the fully-rotated delivery. In the collapsed delivery, the correction factor was more dependent on the chamber type (0.9922-1.0048). For the TomoTherapy®-based IMRT delivery, $k_{Q_{pcsr},Q}^{f_{pcsr},f_{ref}}$ was above unity (1.0037-1.0076) with a 0.3 % measurement uncertainty. However, the correction factor was different by 0.33 % between the Farmer-type chambers and the smaller ionization chambers.

Conclusions: The demonstrated dosimetry techniques carried out the relative dose measurements in the pcsr fields to within 0.3 % 1σ uncertainty level. These dosimetry techniques will be helpful to improve dosimetric accuracy of other nonstandard field deliveries.