Validation of Absolute Dose Measurements for MR-IGRT With and Without Magnetic Field

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Presentations
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Purpose: To validate absolute dose measurements for a MR-IGRT system without presence of the magnetic field.

Methods: The standard method (AAPM’s TG-51) of absolute dose measurement with ionization chambers was tested with and without the presence of the magnetic field for a clinical 0.32-T Co-60 MR-IGRT system. Two ionization chambers were used – the Standard Imaging (Madison, WI) A18 (0.123 cc) and the PTW (Freiburg, Germany). A previously reported Monte Carlo simulation suggested a difference on the order of 0.5% for dose measured with and without the presence of the magnetic field, but testing this was not possible until an engineering solution to allow the radiation system to be used without the nominal magnetic field was found. A previously identified effect of orientation in the magnetic field was also tested by placing the chamber either parallel or perpendicular to the field and irradiating from two opposing angles (90 and 270). Finally, the Imaging and Radiation Oncology Core provided OSLD detectors for five irradiations each with and without the field – with two heads at both 0 and 90 degrees, and one head at 90 degrees only as it doesn’t reach 0 (IEC convention).

Results: For the TG-51 comparison, expected dose was obtained by decaying values measured at the time of source installation. The average measured difference was 0.4%±0.12% for A18 and 0.06%±0.15% for Farmer chamber. There was minimal (0.3%) orientation dependence without the magnetic field for the A18 chamber, while previous measurements with the magnetic field had a deviation of 3.2% with chamber perpendicular to magnetic field. Results reported by IROC for the OSLDs with and without the field had a maximum difference of 2%.

Conclusion: Accurate absolute dosimetry was verified by measurement under the same conditions with and without the magnetic field for both ionization chambers and independently-verifiable OSLDs.