Evaluation of the response of TLD capsules and OSLD nanodot dosimeters in the presence of a magnetic field.

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Introduction: Remote audit programs monitor the output of photon and electron beams on a regular basis to fulfill regulatory requirements, clinical trials participation, and institutions' internal QA needs. The detectors used are OSLD nanodots and TLD LiF powder capsules. The photon beams from an MR Linac unit are one of the most recent delivery modalities incorporated in the radiotherapy environment. The presence of the magnetic field brings new dosimetry challenges that need to be evaluated within the system of verification of output.

Aim: To define the geometry necessary to position OSLD nanodot and TLD capsules for an accurate output check/verification of photon beams from an MR Linac unit.

Method: The 7 FFF MV photon beam from an Elekta Unity with a magnetic field of 1.5 T was used for the irradiations of two types of dosimeters, OSLD nanodot and TLD-100 cylindrical capsules. The capsules were single-loaded (air inside capsule per supplier), single-loaded compressed (air removed in house by compressing the top plug inside the capsule), and double-loaded (double amount of powder, no air, per supplier). Detectors (two OSLD nanodots or three TLD capsules) were irradiated in the center of an acrylic mini-phantom block, using an anterior-posterior beam with field size 10 cm x 10 cm at isocenter (SAD=143.5 cm). See Figure 1.
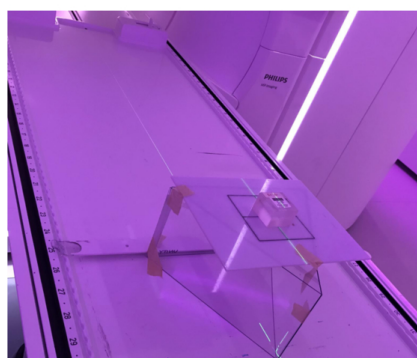

Figure 1: Photon beam block configuration on treatment couch of Unity

Method: Doses delivered to dmax were 100 cGy for OSLD and 300 cGy for TLD. The OSLD nanodots were irradiated with the direction of the magnetic field in the same plane as the face of the carrier. TLD were oriented in two directions, with the capsule axis either parallel or perpendicular to the direction of the magnetic field.

The value used for the evaluation was the ratio of the dose calculated from the OSLD or TLD system to a reference point (dmax) and the nominal dose delivered to the same point. The ratio from the different configurations was compared using T-test for independent samples.

Results:

- The ratio between OSLD dose and delivered dose was 1.004 +/- 0.011. The OSLD result was used as reference value for the analysis of the response of the TLD capsules.

- The TLD capsules oriented parallel to the magnetic field gave results that were not statistically different to the OSLD for the following configurations: single-loaded compressed (p=0.29) and double-loaded (p=0.19).

- Single-loaded TLD and single-loaded compressed capsules showed results that were statistically different (p=0.002) when irradiated parallel to the magnetic field. The average ratio of the calculated/nominal dose was 0.96±0.02 for the single-loaded irradiation.

- The TLD capsules showed a 2.5 % difference in the signal between the two different orientations relative to the magnetic field , with the single-loaded compressed TLD overestimating the output in the perpendicular direction (p<0.05 for all irradiations analyzed).

See table 1 for an example of results from one set of irradiations.

Table 1.: Data for one set of irradiations

Detector	OSLD	TLD Single-loaded	TLD Compress	TLD Double	TLD Compress
Orientation		Parallel	Parallel	Parallel	Perpendicular
AVG ratio	1.004	0.959	1.011	1.013	1.038
Stdev.	0.011	0.019	0.006	0.004	0.004

Conclusion: With the geometry used, the OSLD showed no difference in the response with the presence of the magnetic field. For output checks based on TLD double-loaded or single-loaded compressed capsules, the TLD should be oriented parallel to the magnetic field.

Acknowledgements:

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