PTC17-0229: BioXmark® Remains Chemically Stable Following Normofractionated and Single-Fraction High-Dose Proton Beam Irradiation

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Purpose: Recently, a liquid carbohydrate based fiducial marker (BioXmark®) has been introduced with minimal dose perturbation (relative stopping power = 1.164) and visibility properties suitable for use in image-guided proton therapy (IGPT). In this study we investigated the chemical stability of the marker for use in both normofractionated and single fraction irradiation to a high dose.

Materials and Methods: A QA dosimetry phantom was modified to simultaneously accommodate four cylindrical polymethylmethacrylate (PMMA) inserts. In total, ten identical (PMMA) inserts were custom-made: BioXmark® markers were added at the bottom of the inserts, water was added on top of the markers and they were sealed. Using the modified QA dosimetry phantom, the PMMA inserts were placed sideways into the proton irradiation field. Four markers (Group A) were irradiated during daily QA to an accumulated dose of 67.4 Gy in 43 fractions, four other markers (Group B) were irradiated with a single dose of 155.4 Gy, and two non-irradiated inserts served as control markers. High-performance liquid chromatography (HPLC), electrospray ionization mass spectrometry (ESI-MS), thin-layer chromatography (TLC) were used for chemical assessment of the irradiated BioXmark® markers and the overlying aqueous phase.

Results: There were no visually apparent changes in any of the inserts. HPLC, TLC and ESI-MS analysis of the markers and the aqueous phase did not indicate chemical degradation in any of the groups.

Conclusion: The BioXmark® marker showed no chemical degradation after exposure to high-dose normofractionated and single-dose proton beam irradiation and may serve as a good alternative to solid fiducial markers currently used for IGPT.

Source:
(*2017*) Proceedings to the 56 Annual Meeting of the Particle Therapy Cooperative Group (PTCOG), 8-13 May 2017. International Journal of Particle Therapy: Summer 2017, Vol. 4, No. 1, pp. 14-83.