AbstractID: 10206 Title: First MR images obtained during megavoltage photon irradiation from an integrated linac-MR system

Purpose: To prove whether our hybrid linac-MR design can sufficiently decrease mutual magnetic and radio frequency (RF) interferences to produce a MR image during linac-irradiation that has similar geometric accuracy and image contrast to an MR image obtained without linac-irradiation. **Method and Materials:** A hybrid prototype has been built consisting of a 6 MV linac mounted on the open end of a bi-planar 0.2 T permanent-magnet MR system. Both the linac waveguide and the MR system are mounted onto a single gantry that would rotate around a subject. The permanent magnet poles (82x82 cm^2) are rigidly held apart to give 27.9cm pole-to-pole opening with flat gradients (40 mT/m max) running under a TMX NRC console (Canada). The linac components are comprised of salvaged magnetron-based Varian 6 MV 600C decommissioned system. The distance from linac target to MR isocentre is 80 cm. Magnetic and RF shielding calculations were performed by finite element analysis and confirmed with appropriate measurements. Faraday cage shielding, typical of all MR installations, was also provided. The testing phantom was an acrylic rectangular cube, 15.95 x 15.95 x 25.4 mm with holes of diameters 2.52 mm, 3.45 mm and 4.78 mm drilled parallel to the length (25.4 mm) of rectangular cube. The cube was immersed in a 10 mM solution of $CuSO_4$ within a plastic container 22.5 mm inner diameter. The container with the cube insert were placed inside an inductively tuned solenoid RF coil with an integrated pin-diode transmit/receive switch. **Results:** Images (128x128) were obtained in about 38 secs using raw gradient echo sequences. Compared to no-radiation, MR images during linac-radiation had no geometric distortion but slightly reduced SNR. **Conclusion:** Our linac-MR design produces MR images obtained during or without linac irradiation that are sufficiently similar to implement real-time MR-guided radiotherapy.