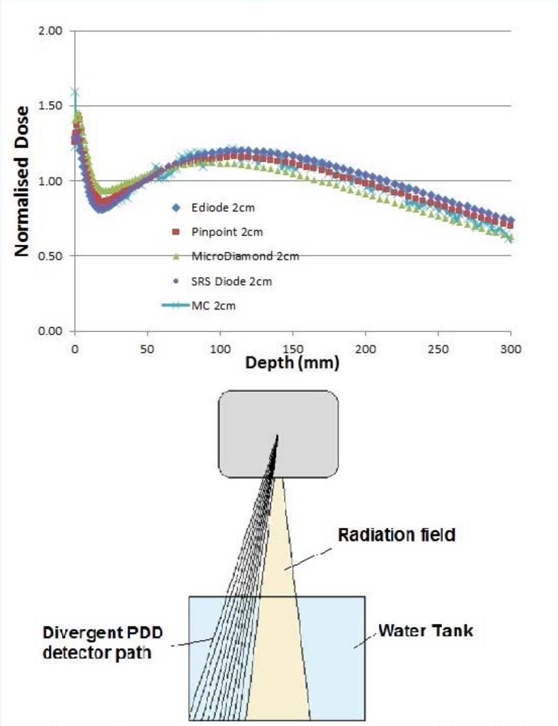

Fig. 1 Top: Divergent PDD acquired 2cm from the radiation field edge and Bottom: Divergent PDD measurement set-up

This results in a Dmin occurring out-of-field at approx. the same depth where Dmax occurs in-field. However at 15cm from the field edge the second build-up region disappears for all detectors. The measured divergent PDDs agree to within 0.5% of each other over the range of out-of-field distances examined. Initial comparison to MC reveal good agreement however the MC PDDs have a large statistical uncertainty.
Conclusions: The detectors used in this study show similar response to out-of-field radiation. Concern over the predominance of low energy photons out-of-field causing an over-response in detectors is not evident in this study. The presence of the Dmin could have clinical implications for out-of-field dose measurements (e.g. scatter diodes measuring Dmin). Future work will be completed in comparing the measurements and MC to a variety of TPSs to identify the accuracy of different TPSs for out-of-field dose. Also measurements will be repeated for other clinically available detectors and improvements in the statistical uncertainty of the MC dose calculation will be completed.

PO-1007

Neutron induced soft errors in cardiac implantable devices following radiation therapy

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Purpose/Objective: Malfunctions of Cardiac Implantable Electrical Devices (CIED) have been described in patients undergoing radiation therapy. Damage can be observed even in the absence of direct exposure to ionizing radiation beams, due to diffusion of neutrons (n) causing 'soft error' in the CIED circuits. Neutrons are produced by nuclear reaction in the head of linear accelerators operating at beam energies ≥10 MeV and this can be source of pacemaker (PM) and implantable defibrillator (ICD) malfunctions. The aim of this study is to assess the risk of CIED malfunctions in patients undergoing radiation treatment of the pelvic region.
Materials and Methods: Different models of working CIEDs, explanted from patient to prevent battery drain, were placed on a neutron tissue equivalent anthropomorphic phantom and irradiated with a 15MV photon beam on a VARIAN CLINAC 2100C linear accelerator, simulating a 3D prostate radiotherapy course (70 Gy). Photon radiation and neutron doses at the CIED site were measured. A dosimetric film GAFCHROMIC-EBT2 was used to quantitatively evaluate the radiation gamma-dose absorbed by the CIED. Neutron dose was measured with bubble dosimeters for both thermal and fast neutrons and CR-39 track etch detectors. The radiation emitted by the exposed devices has been used to assess whether their activation could be associated with the capture of thermal neutrons. For this purpose we used a High Purity Germanium detector for gamma spectrometry. All devices were measured before and after irradiation.
Results: Fifty-nine devices, 34 pacemakers (PMs) and 25 implantable defibrillators (ICDs), were analyzed. No malfunctions were detected before irradiation. After irradiation a software malfunction was evident in 13 (52%) ICDs and 6 (18%) PMs, despite a negligible thoracic X-radiation dose and no electromagnetic field detected with specific EM-field measuring devices.
The measured neutron dose in the CIED region was 19±4 mSv. Neutron capture was demonstrated by the presence of the isotope ^{198}Au (^{197}Au+n) or ^{192}Ir (^{191}Ir+n) in the devices and was greater in ICD than in PM.
Conclusions: High energy radiation therapy can determine CIED malfunctions even in absence of direct exposure to the X-radiation beam, because of the diffusion of neutrons produced by the linear accelerator, causing 'soft errors' in the circuits. In our experimental model we simulated a complete radiotherapy treatment for prostatic cancer on an anthropomorphic phantom designed for neutron dosimetry. Despite the absence of significant photonic radiation and any electromagnetic field in the thoracic zone, some malfunctions were detected in 52% of ICDs an 13% of PMs. The year of production did not seem to be correlated with the risk of PM malfunctions, while damaged ICDs were older than those without malfunction. Malfunctions are more frequent in ICDs than in pacemakers.

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Validation of a photon peripheral dose model for IMRT treatments

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