Evaluation of uncertainty in dose estimation using L-band EPR spectrometer using intact tooth

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In an unexpected large scale event of radiation exposure, swift determination of dose is required to identify potential victims needing immediate medical care. Recently, L-band electron paramagnetic resonance (EPR) tooth dosimetry have been introduced as a international standard, ISO 13304 as a reliable in vivo dosimetry tool for the rapid response to determine dose to tooth without extraction or damage. However, information of list of affecting parameters for uncertainty in EPR tooth dosimetry have not been investigated yet. Then, we aim to estimate the uncertainty in dose estimation procedures using radiation treated cases.
Human tooth sampes were irradiated with calibrated 6 MV photon beam. Verification plans were generated on the CT images of custom-made polymethyl methacrylate head phantom. Based on theses acquired CT images, the structures of incisors were separately contoured. The mean doses were then calculated using treatment planning system (TPS). We conducted the measurements of EPR signal from incisors using home-built EPR spectrometer. The relative uncertainties in dose estimation in axial movment and rotational movement of tooth were separately evaluated using finite element analysis. The estimated relative uncertainty in tooth sample in axial movement was 15.3%. The estimated relative uncertainty in rotational movement was 7.2%. Based on these results, we also estimated the combined relative uncertainties in dose estimation from constructed calibration curve. The combined relative uncertainties (2σ) in dose estimation for EPR tooth dosimetry as a function of dose were well accordance with relative differences in estimated dose and applied dose from TPS. Our results also demonstrated that the use of dose from TPS can be used in dose estimation in L-band EPR tooth dosimetry.

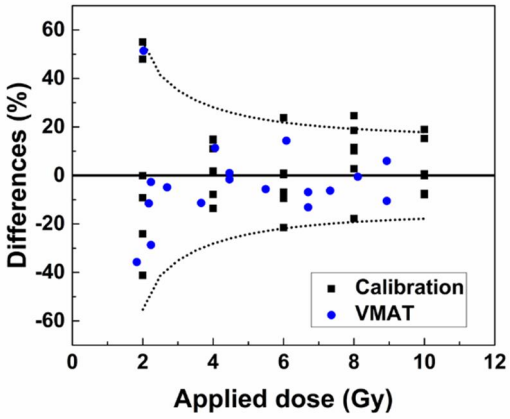

Figure 8. The results of estimated dose for whole measurements from twelve incisors. The relative uncertainties of dose estimation as function of dose were also described as dashed lines.

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