Estimation of Radiation Doses of Teeth Using *In Vivo* EPR Spectroscopy

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There are plausible circumstances (e.g. terrorism) in which large populations could be exposed to doses of ionizing radiation. During a radiological/nuclear emergency, the first responders and affected public can be exposed to clinically significant doses of radiation. Rapid and optimal dose assessment, especially for non-uniform exposures, that delivers timely assessment results is very important for immediate and near-term consequence management.

EPR spectroscopy was recognized almost 50 years ago as a method that could be used to measure ionizing radiation doses received by humans, through measurements on teeth or bone. These measurements are based on the generation of stable free radicals in these tissues whose densities are proportional to the total dose of radiation. However, these measurements have required removal of the teeth or bone samples for the assay. EPR dosimetry with teeth has usually been performed at the more sensitive high frequency X-band (9~10 GHz) *in vitro*. Low frequency L-band (~1.2 GHz) EPR spectroscopy has the potential for making accurate and sensitive measurements of the radiation dose in teeth without removing the teeth from the mouth. We have developed techniques and methods to perform EPR dosimetry using intact teeth. L-band EPR spectroscopy is non-invasive and applicable to individuals and can also provide the output immediately after the measurement, which would be crucial for effective management of large incidents.

We have made measurements on specifically irradiated molar teeth placed in appropriate gaps of healthy volunteers' dentition, and in the natural teeth of patients who have completed courses of radiation therapy for head and neck cancers that resulted in significant doses to the teeth. Based on measurements of five teeth irradiated to doses between 0.5 and 10 Gy and averaging of 3 sets of independent measurements, estimates of the absorbed dose have a standard error of dose prediction (SEP) of about ±1 Gy. For single measurements the SEPs were higher, generally near 1.5Gy. The time required for data collection was about 8 min per tooth, including computer overhead and spectrometer tuning. These data support the expectation that *in vivo* EPR dosimetry can provide the data needed for an effective triage of a population exposed to radiation in the range that can cause acute clinical syndromes.

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