

Development of MATHELDE: a Machine Learning Approach for Tooth Enamel Dose Estimation.

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Retrospective electron paramagnetic resonance (EPR) dosimetry of tooth enamel is a validated method for dose reconstruction after radiation exposure. However, conventional acquisition often require several hours per sample, limiting their use in large-scale radiological emergencies, where rapid triage is needed to identify individuals exposed to clinically relevant doses (≥ 2 Gy). To address this challenge, we present MATHELDE, an AI framework for fast tooth enamel dose assessment. A dedicated dataset was generated from enamel samples irradiated at known doses in the range 0,1-3 Gy and measured using fast EPR acquisition protocols, achieving an approximately tenfold reduction in measurement time. These data were used to train a classification model to discriminate samples above the 2 Gy threshold. The model was validated on an independent set of samples irradiated at unknown doses. Performance obtained from fast-acquisition spectra was compared with that achieved using standard EPR protocols to evaluate classification accuracy and quantify time savings. The study demonstrates the potential of combining deep learning and fast EPR acquisition for rapid triage in radiation emergency.