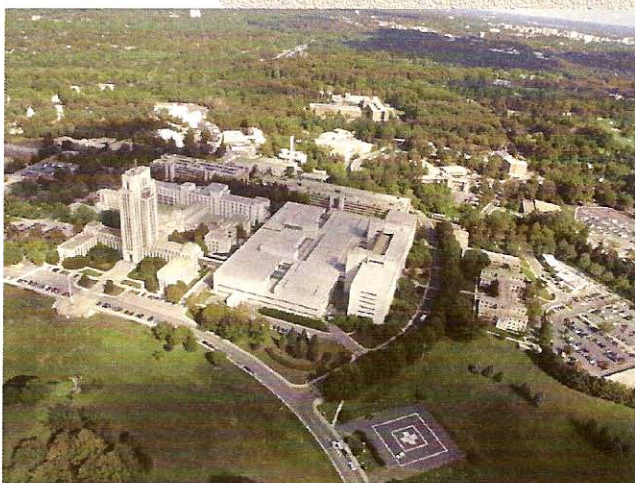


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Radiation Exposure Measurements for Military Participants in US Nuclear Weapons Tests Using EPR in Dental Enamel

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The criteria for ideal exposure measurements suitable for dose-response analysis in epidemiology for military participants in U.S. nuclear weapons tests ("Atomic Veterans"), as prescribed by the "Five Series Study" (Nat' Acad Press, 2000), are: (1) individual specific, (2) recorded by time, duration and dose, (3) sensitive to different radiation components of exposure, (4) previously validated for use in similar situations, (5) complete: cover all exposures for all people, and (7) accepted by all interested parties. An additional requirement can be adequate sensitivity (LLD).

This report will discuss how well EPR dosimetry in dental enamel satisfies these criteria. In addition, it will present a history of preliminary EPR measurements on enamel samples obtained from teeth discarded in the normal course of dental treatment of the so-called Atomic Veterans. Difficulties in dose calculations and interpretation of the EPR data will also be covered. In particular, problems associated with separation of the doses due to exposure to high-energy gamma-rays from the dose due to medical diagnostic x-rays will be reviewed.

Dental enamel maintains a record of a tooth's exposure to gamma- and x- radiation. The absorbed dose is stored in the form of long-lived free radicals that can be detected using Electron Paramagnetic Resonance (EPR). Aldrich and Pass in 1986¹ developed a technique using EPR for separating the contributions from diagnostic and high energy radiation to total exposure. They then applied this technique to enamel obtained from discarded teeth of Atomic Veterans. Preliminary results published in 1989² indicated exposures to medical diagnostic radiation may be significantly higher in this cohort as compared to the general population. This study was, however, limited by, among other factors, the low sensitivity of the Varian EPR spectrometer used at that time.

The veterans enamel samples were measured again in 1999-2000 using a state-of-the art Bruker EPR spectrometer. This report will review the results of the 1989 study and the analyses currently underway of the newest data. The problems encountered with both data sets and, consequently, the suitability of EPR in dental enamel for epidemiologic studies of the veterans cohort will be then be addressed.

¹Aldrich, J.E., and Pass, B. Dental enamel as an in-vivo dosimeter: separation of the diagnostic x-ray dose from the dose due to natural radiation. *J. Radiat. Prot. Dosim.*, 17, 175-179 (1986).