Determination of the average native background and the light-induced EPR signals and their variation in the teeth enamel based on large-scale surveys of the population of different regions

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Study Goal: To determine average intensity and variation of the native background signal (BGS) and of the solar light induced signal (LIS) in EPR spectra of tooth enamel for different kinds of teeth and different groups of people. These values are necessary for determination of the intensity of the radiation-induced signal (RIS) by subtraction of the expected BGS and LIS amplitudes from the total signal amplitude measured in L-band for in vivo EPR dosimetry.

Abstract: The analysis of several hundred of the EPR spectra that were measured earlier at X-band at a large-scale examination of the population of the Bryansk region (central part of Russia) and Semipalatinsk region (Kazakhstan) was performed. The average values and the variation of the amplitude of the BGS for the teeth from different positions, as well as LIS in outer enamel of the front teeth for different population groups were determined.

To convert the obtained data to the values corresponding to the conditions of measurement in the L-band, the experimental dependences of the intensity (the amplitude of the signal measured in the form of the first derivative and the second integral) of RIS, LIS and BGS on the mw power, measured in X-band for various types of resonators and measured at L-band (taken from publication of Iwasaki et al., 2005) were analyzed.

For in vivo dosimetry, the middle upper incisors are used. For these teeth the mean LIS annual rate induced only in the outer enamel was obtained=(12.0+-1.6) mGy/yr, variation=(7.5+-1.5) mGy/yr (62%), n=21. For example, for a 40 yr old person (enamel age 30 yrs) LIS=(0.36+-0.05) Gy with variation 0.22 Gy. The saturation behavior for LIS is not significantly different from RIS, therefore no conversion for LIS is necessary.

For a Bruker’s standard cavity (Q=2000) measured at X-band under conditions of saturation (mw power 10 mW), the mean BGS max amplitude in enamel for the first upper incisors was determined to be (0.72+-0.05) Gy; variation=(0.20+-0.05) Gy (28%) ; n=20. This corresponds to (1.8+-0.2) Gy with variation 0.50 Gy in conditions without saturation.

The total average intensity of BGS (the 2-d integral of the registered signal) was estimated, expressed in terms of concentration of spins in enamel as (6.6+-0.6)e13 spins/g based on the published data of Hassan et al., 2010) for RIS (2.8e13 spins/g/Gy).
**Conclusion:** The obtained mean value of LIS may be used directly for subtraction from the total signal amplitude in L-band at RIS determination for the upper incisors. Its variation should be taken into account as a contribution to the error of dose determination. The obtained mean value and variation of BGS without saturation should be taken into account at estimation of its contribution to the total signal accounting for the specific saturation behavior of the BGS in L-band.

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