

EPR DOSIMETRY RECONSTRUCTION of DOSE LOAD FORMED in TEETH by X-RAY IRRADIATION

Kirillov, Vladimir; Kuchuro, Joseph; Tolstik, Sergey

Belarusian State Medical University,
23 Philimonova Street, Minsk 220114, Belarus.
Corresponding author: kirillov@bsmu.by

It is known that under the effect of X-rays and γ -irradiation paramagnetic centers having identical spectral characteristics are formed in tooth enamel. In the emergency situations, the dose load is mainly formed due to external γ -irradiation. However, the tooth enamel dose can also be formed during the diagnostic X-ray examination of the maxillo-dental system. In the process of X-ray examination, the teeth, the jaw and the skull undergo local irradiation, while during the emergency situations, the whole body is exposed to irradiation. In other words, the exposure to X-rays may lead to an irregular increase of the dosimetric signal in the EPR tooth enamel spectra.

The comparative analysis the EPR tooth enamel spectra irradiated with the applied dose of 5Gy from the ^{60}Co source and on an X-ray machine with standard for roentgen diagnostic characteristics of the tube ($U=70$ kV, $I=10$ mA, Al 2.5 mm) has been performed. It has been shown that with the identical dose of irradiation, the intensity of the EPR signal induced by X-rays exceeds almost ten times the amplitude of a signal from paramagnetic centers formed under the effect of γ -irradiation. While using standard EPR dosimetry technique, this should lead to an increase in the measured dose.

To confirm this, a series of experiments was conducted, where the teeth taken from individuals not exposed to diagnostic X-ray examination were used. In one series, 9 pairs of one and the same tooth (taken from the side of the cheek and the tongue) were previously irradiated with the applied doses of 100, 250 and 500 mGy (three pairs for each irradiation) on an X-ray machine. In the other series of experiments, 9 pairs of the teeth were previously irradiated with the same doses and by the same pattern on dosimetric ruler. The halves of teeth were used for enamel preparations, the dose load being measured by their EPR spectra. Calibration straight lines were constructed with the help of the additive dose method using either standard (additional irradiation was performed on dosimetric ruler) or nonstandard (on an X-ray tube) additional irradiation. It has been determined that the presence in tooth enamel of paramagnetic centers induced by X-rays led, on the average, to a nine-fold increase in measured doses, as compared with applied doses. In this case, individual radiation sensitivity of enamel was determined with the help of the additive doses method from the γ -source. In the opposite situation, when the dose load was formed due to γ -irradiation and the additional irradiation was performed on an X-ray tube, the dose loads decreased, approximately, ten-fold. At the same time, if the formation of doses and additional irradiation were performed from the same sources of irradiation, i.e. due to X-rays or γ -irradiation, then the value of the measured dose was practically equal to that of the applied dose. The analysis of the obtained results shows that for adequate reconstruction of individual absorbed doses by EPR tooth enamel spectra, additional irradiation should be performed from electromagnetic irradiation sources having equal energy with the external irradiation forming the dose load.