APPLICATION OF EPR DOSIMETRY AS A GOLD STANDARD: THE ROLE OF CONFOUNDING FACTORS

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One of the applications of EPR dosimetry with teeth is for validation of other retrospective dosimetry techniques and verification of historical dose records. This role of EPR dosimetry is justified by accuracy and sensitivity threshold (±25 mGy and 50 mGy, respectively), which are superior to other dose reconstruction techniques (e.g. FISH biodosimetry or RADRUE analytical dose reconstruction). EPR dosimetry with teeth was broadly used in this role for Chernobyl clean-up workers, workers of Mayak or Semipalatinsk inhabitants.

However, superb metrological abilities of EPR dosimetry with teeth, which were demonstrated for assessment of cumulative dose to a sample are hampered by effect of various confounding factors, contributing to cumulative dose of a real tooth. Among those the most notable are: possible contribution of UV-induced paramagnetic centers, lifetime natural background dose, dental x-ray procedures, variations in radiosensitivity of individual samples. These problems are well known and many of them had been addressed in previous studies. However, when EPR dosimetry is used as a gold standard for validation of other techniques, requirements to the accuracy of EPR measurements are very high and, therefore, dubious samples with possible contribution of UV or dental x-rays should be rejected.

One of examples of application of EPR dosimetry with teeth as a gold standard was validation of RADRUE –interview based technique for assessment of doses received by Chernobyl clean-up workers. In this study the tooth donors (91 subjects) were interviewed and their doses were estimated using RADRUE technique. Rigorous analysis of discrepancies between EPR and RADRUE dose estimates helped to identify some shortcomings of RADRUE and modify the technique. However, in some situations EPR doses showed substantial overestimation of respective RADRUE values and, moreover, upper estimates of possible doses received by subjects of the study. In order to investigate possible causes of such discrepancy and search for possible unaccounted irradiation situations (past occupational exposure, unreported Chernobyl episodes, medical irradiation) 30 subjects were approached for more detailed yet less formal interviews. Among those 15 subjects had discrepant EPR and RADRUE dose estimates and 15 other were used as a control. This sub-study did not reveal any unaccounted occupational exposures or unreported Chernobyl activities, though each of the subjects with large discrepancy in dose estimates had medical irradiation (radiotherapy of diagnostic). Nature of such irradiation varies, possible doses to teeth involved can be only qualitatively assessed.

This finding proved that such irradiation may have significant contribution to EPR dose and need to be ruled out if EPR dosimetry with teeth is intended for use as a gold standard. Ignoring such effect may lead to inadequate results and diminish the value of EPR dosimetry as a tool for validation of other techniques or verification of historical dose records. The design of such validation studies should include not only account and quantification of well known confounding factors (like dental x-rays or natural background), but also exclude participation of the subjects with large whole- or part-body medical irradiation.