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EPR dosimetry for actual and suspected overexposures during radiotherapy treatment

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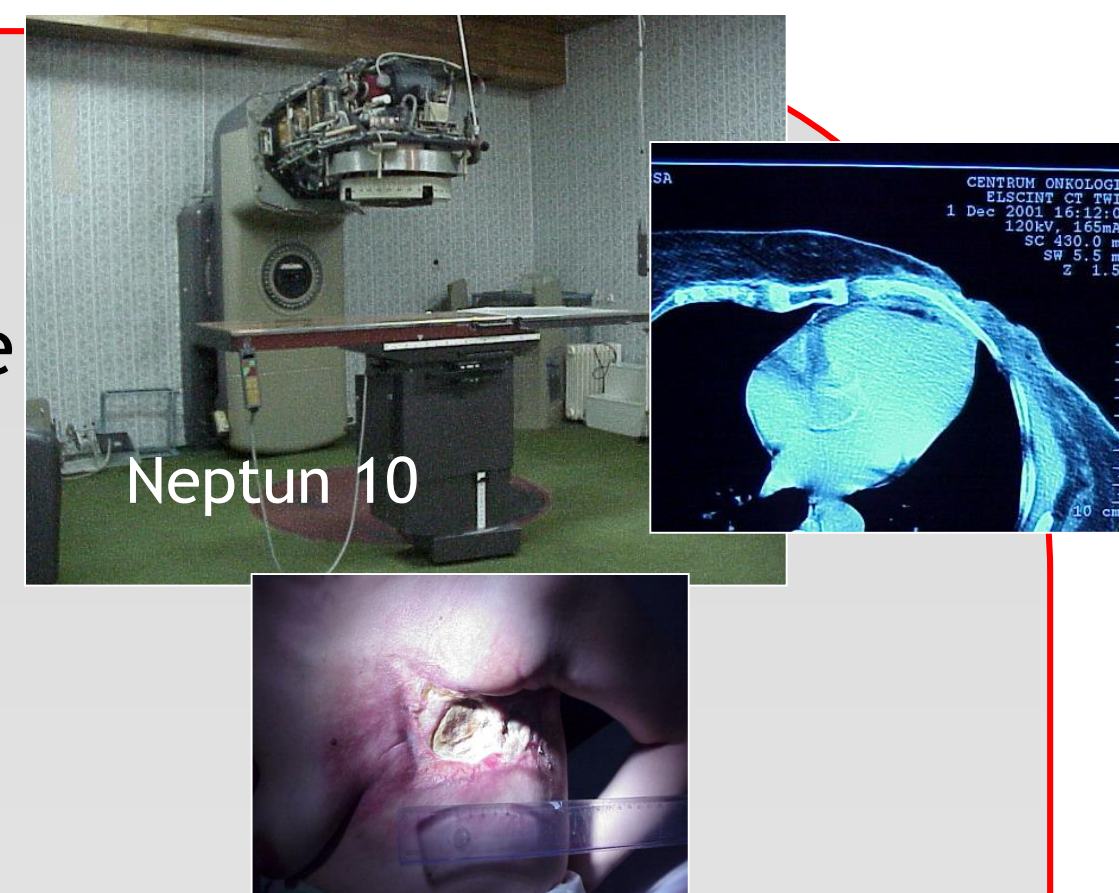
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EPR dosimetry was used to estimate the doses on rib bone samples removed from actual and suspected overexposed patient during radiotherapy treatment

Case n° 1: Dose assessment for a radiotherapy accident

The recognized overexposure occurred on February 27th 2001 in the Bialystok Oncology Center, when five breast-cancer patients undergoing radiotherapy received a single, high dose of 8 MeV electrons generated by a Neptun 10p linear accelerator. The ultimate cause of the accident was a defective safety interlock and an obsolete safety system of the Neptun 10p accelerator leading to a large increase of the dose rate. All patients experienced immediate pain and skin reddening, followed by moist desquamation and development of deep necroses by autumn 2001.

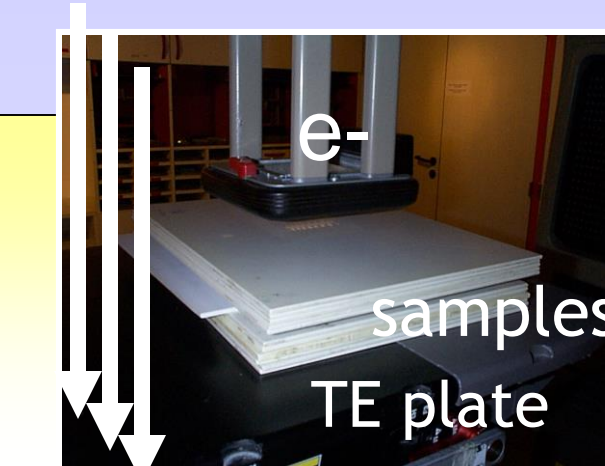


Case n° 2: investigation for a suspected overexposure

In 2005, a patient developed necrosis in the right axillary region formerly irradiated (9MV photon) during "standard upper mantel fields" therapy for an Hodgkin's disease in 1999. A late effect of an overexposure during the treatment was considered as a plausible hypothesis for the necrosis appearance.

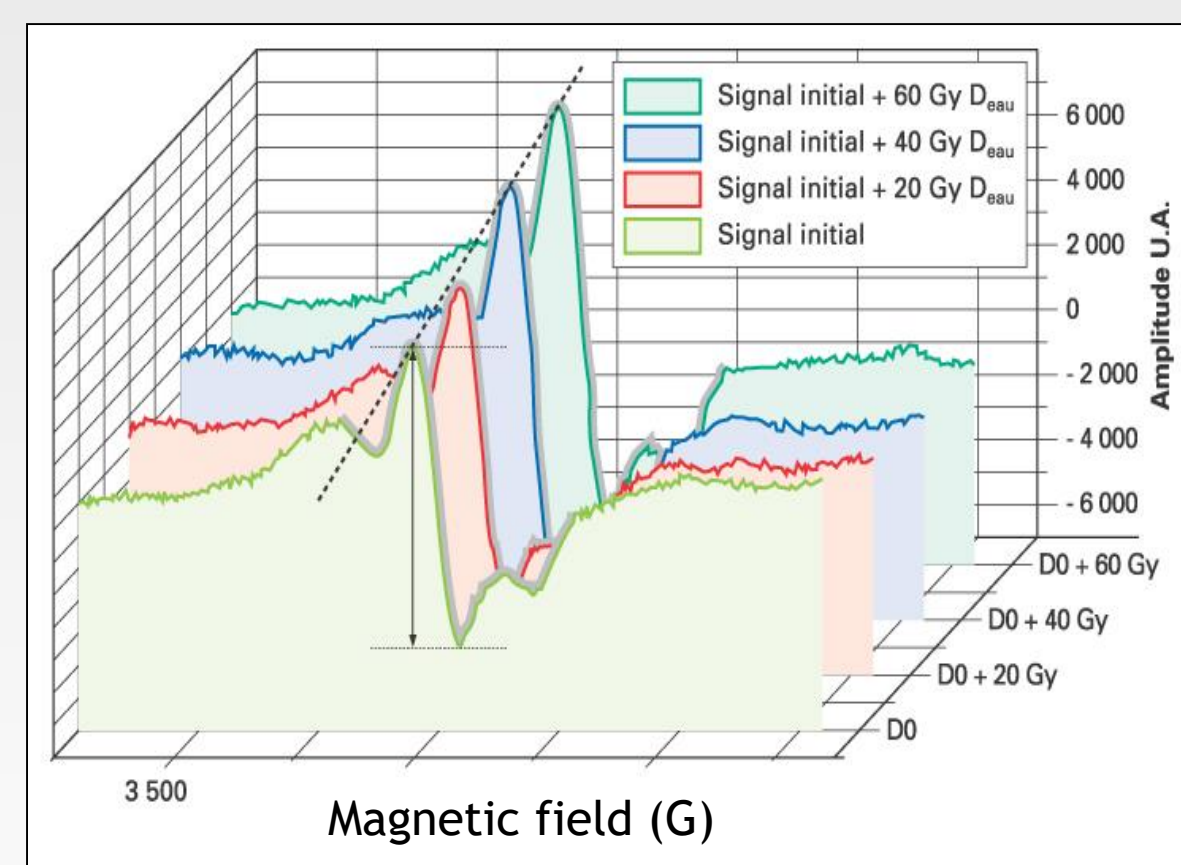
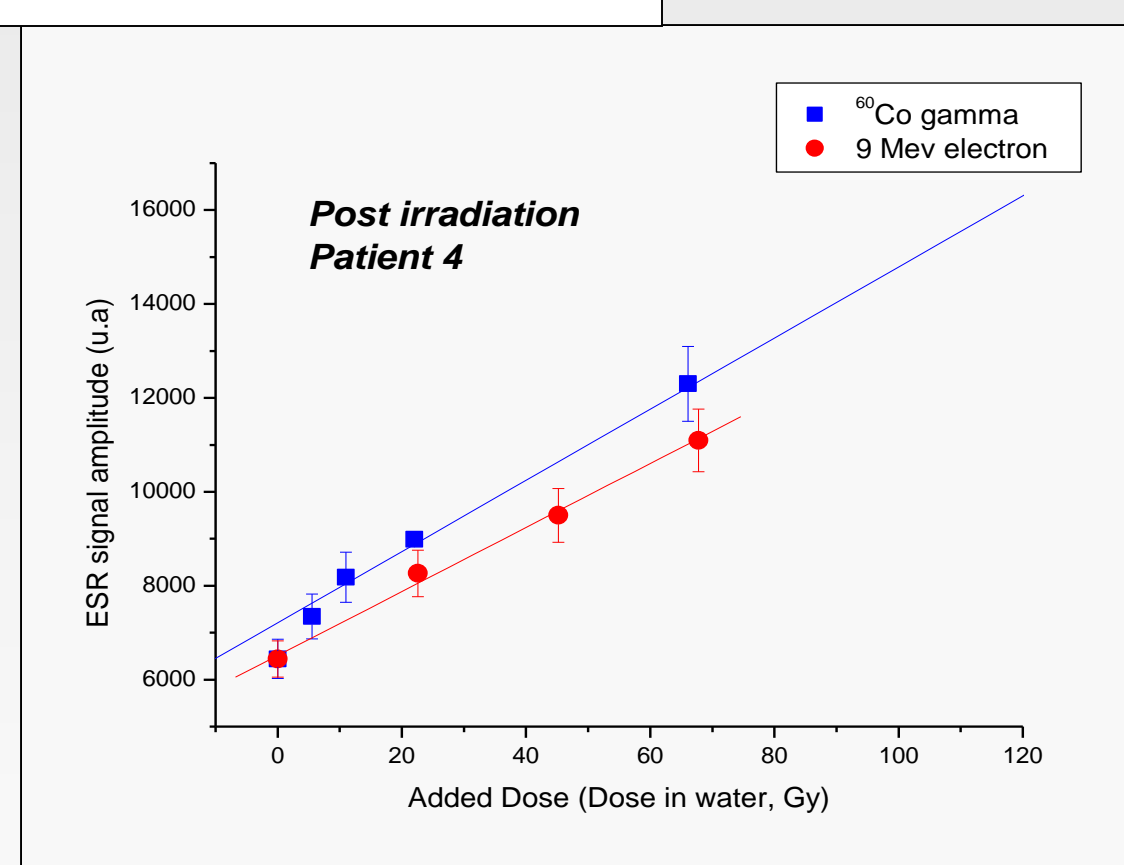
Materials and methods

Doses were assessed by the dose addition method on cortical part of rib bone sample. Post irradiation performed using 9 MV electron (IRSN) and ⁶⁰Co gamma (INCT) for Bialystok accident samples and ⁶⁰Co gamma (IRSN) for the case n°2. Variation of beam and energy response was taken into account when necessary.

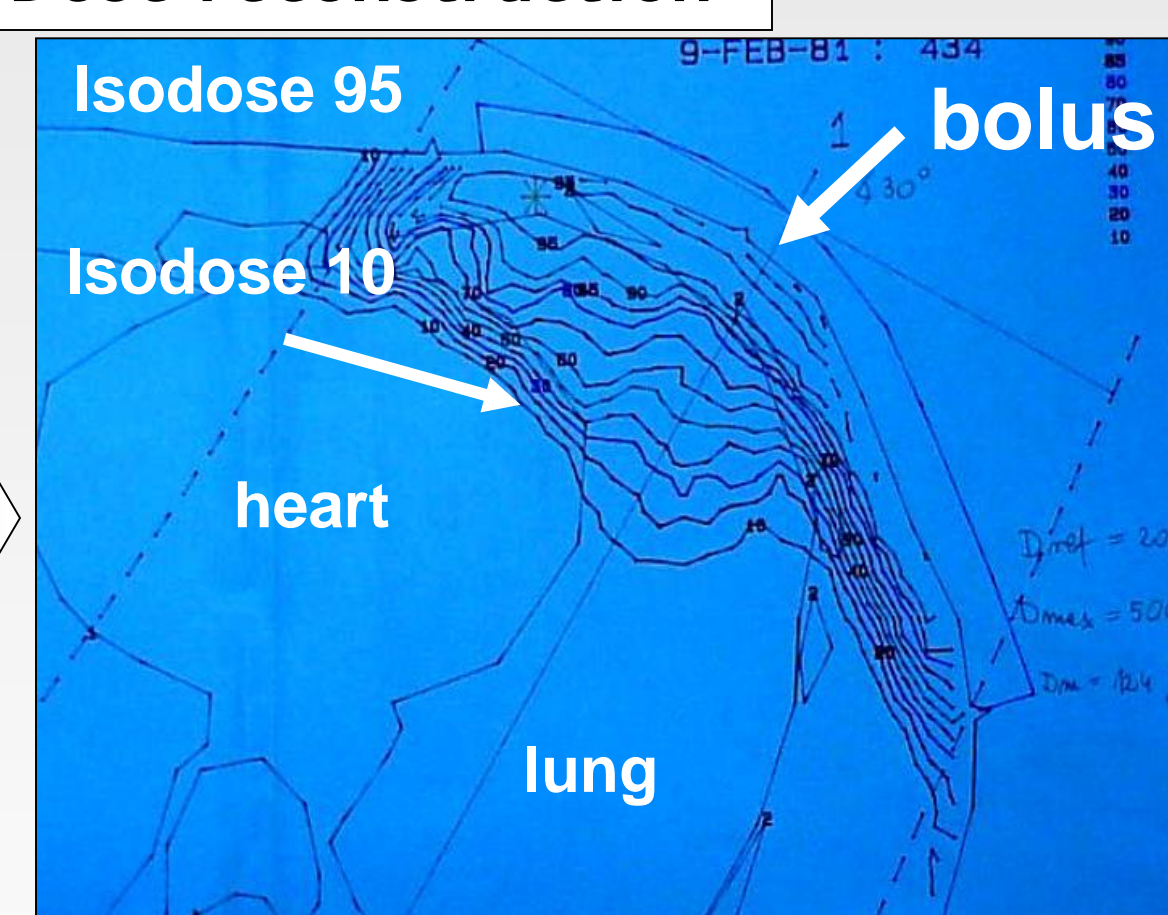


Post-irradiation with 9 MV e- at the Institut Curie (France) for Bialystok samples

Dose estimation

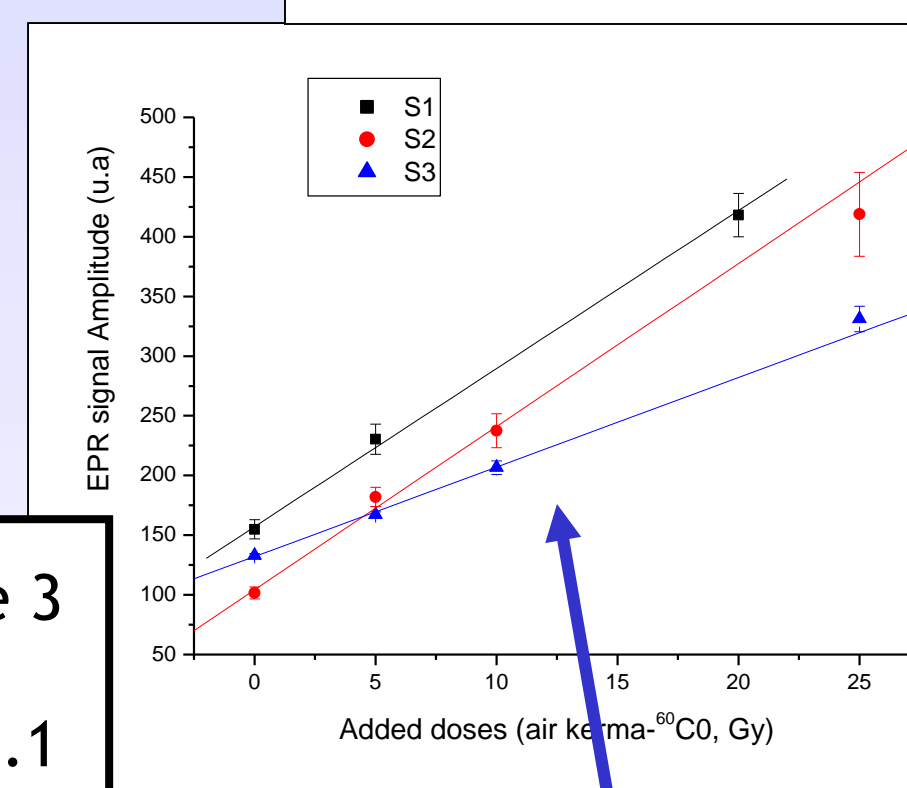
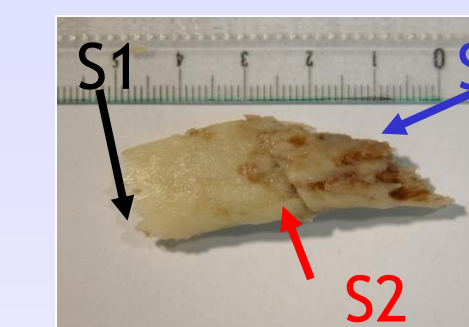


Dose reconstruction



Dose estimation

3 samples from the rib bone: S1, S2 and S3



Dose results

	Sample 1	Sample 2	Sample 3
EPR dose (Gy)*	6.9±0.7	4.5±0.7	10.2±1.1
Slope of LR**	13.2±0.6	13.7±1.1	7.5 ±0.4

*in tissue kerma corrected from energy variation
**slope for LR in air kerma, ⁶⁰Co

Sensitivity variation due to necrosis effect on bone

Total dose measured on rib bone by EPR (Gy)

	Patient 3	Patient 4	Patient 5
Total EPR dose (IRSN)	83±7	98±10	75±3
Total EPR dose (INCT)*	95±5	95±6	-
Dose before accident**	25±0.3	39 ±1	5 ±0.3
Accident Dose**	58±7	59±10	70±5

*Correction factor e-/γ : 1.11

** from Accidental overexposure of radiotherapy patients in Bialystok, IAEA, Vienna, 2004

Good agreement between EPR results

Differences and uncertainties for dose reconstruction based on EPR data are coming from:

- Accuracy of sample position
- Fast attenuation of electrons
- Accuracy on cumulative dose before accident
- Effect of necrosis on ESR signal

•Problem for dose reconstruction, no available data to correct measured doses from the loss of EPR signal due to bone remodelling and the influence of necrosis on signal loss and dose sensitivity

•No conclusions on radio-induced origin of the pathology

These two cases show that EPR can provide useful data and that some specific studies on bone dosimetry are necessary to improve analysis of data