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EPR dosimetry for actual and suspected overexposures during radiotherapy treatment

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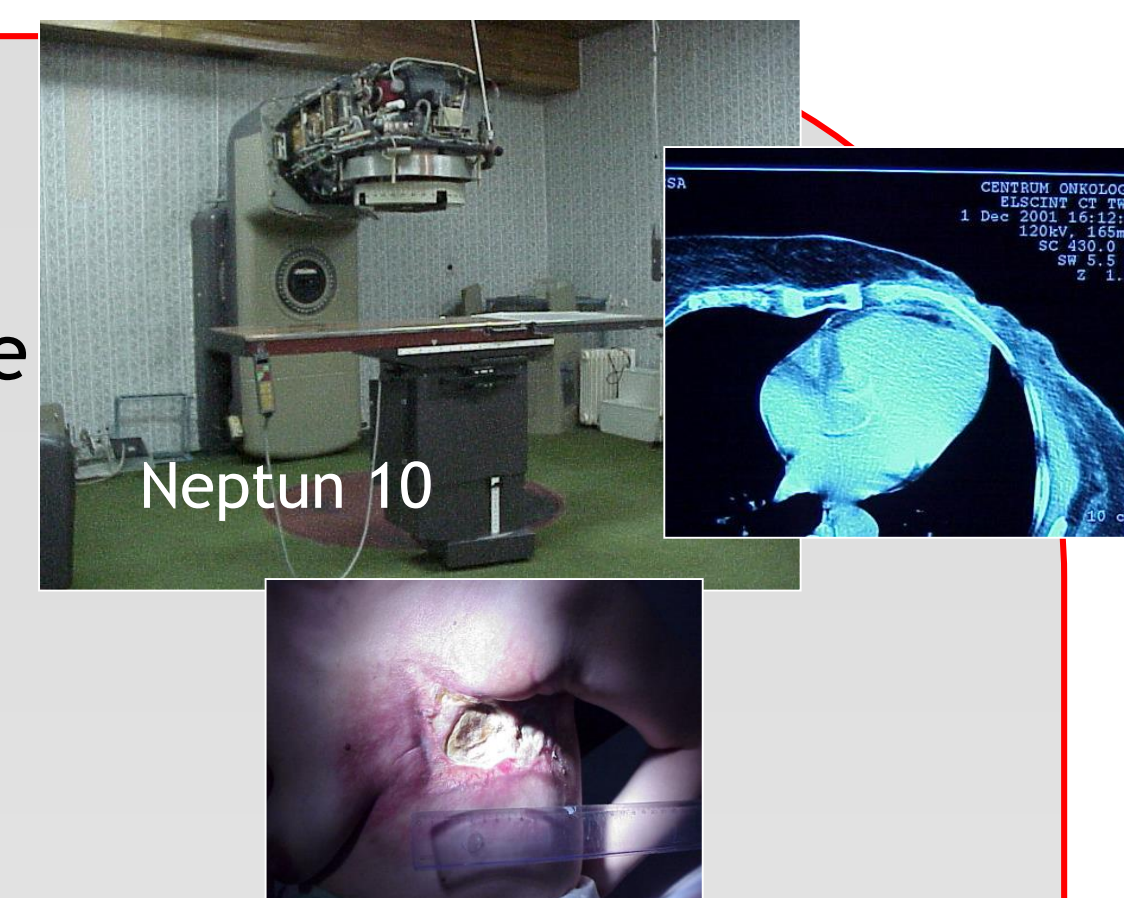
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EPR dosimetry was used to estimate the doses on rib bone samples removed from actual and suspected overexposed patient during radiotherapy treatment

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.

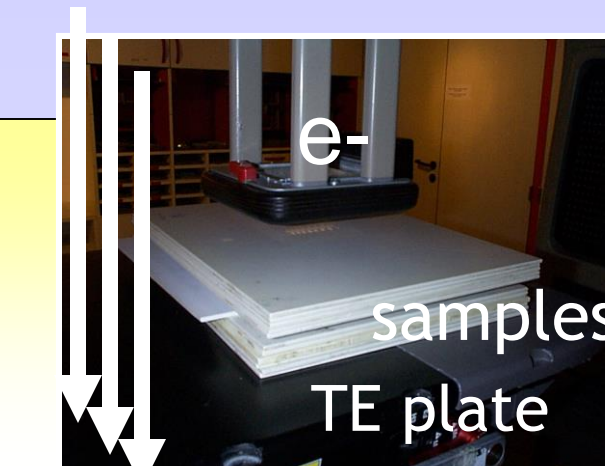


Case n° 2: investigation for a suspected overexposure

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 an plausible hypothesis for the **necrosis appearance**.

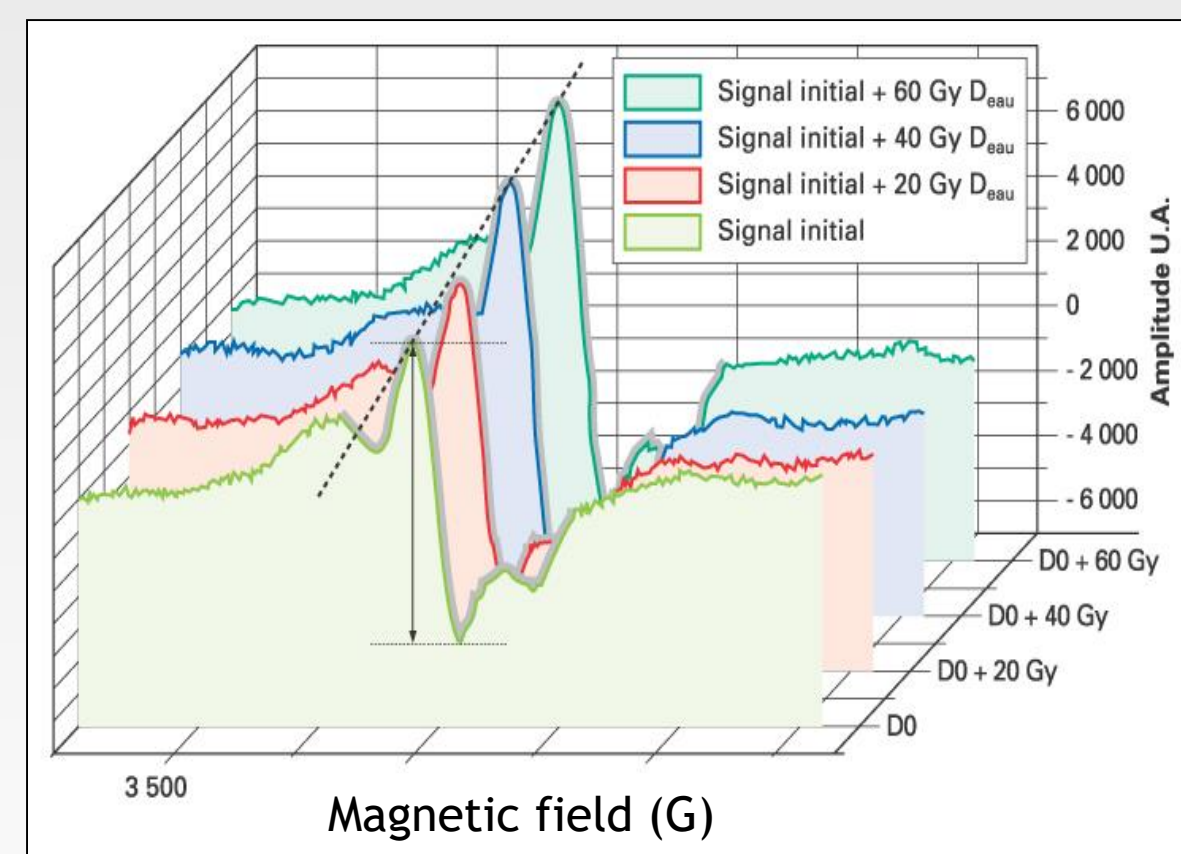
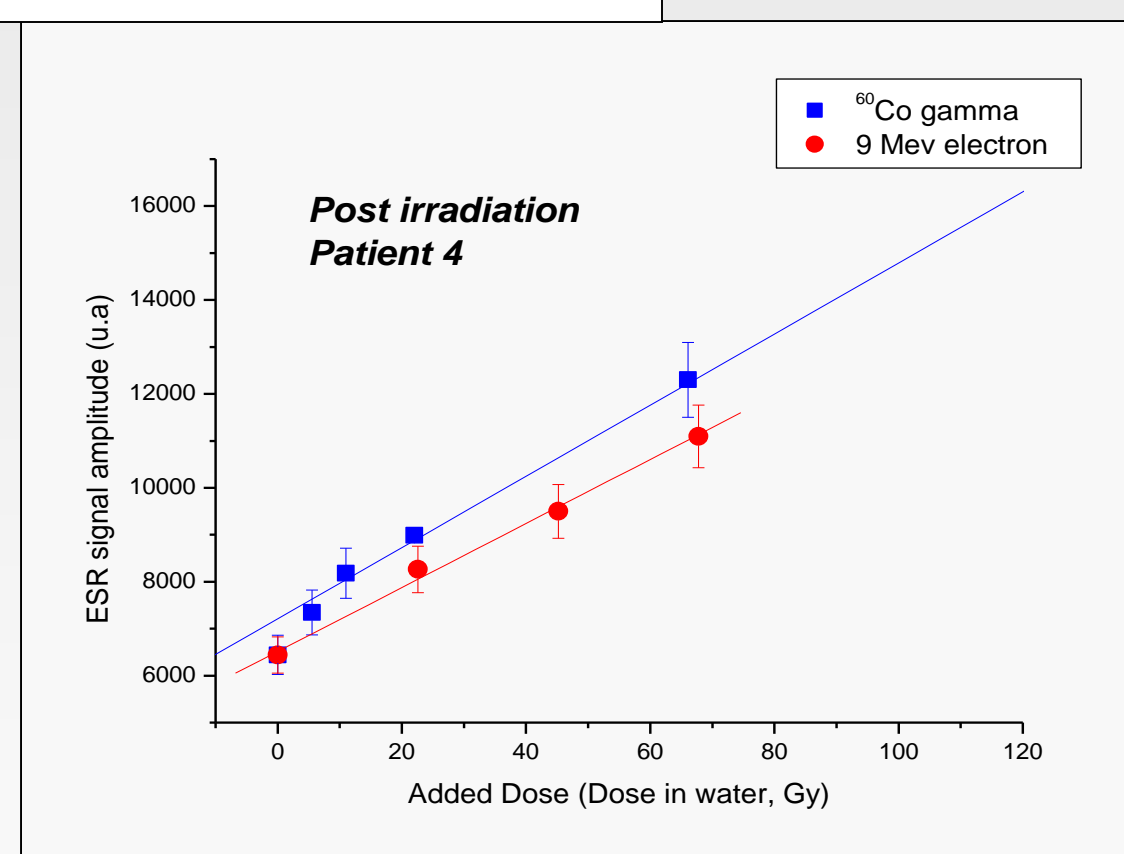
Materials and methods

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.

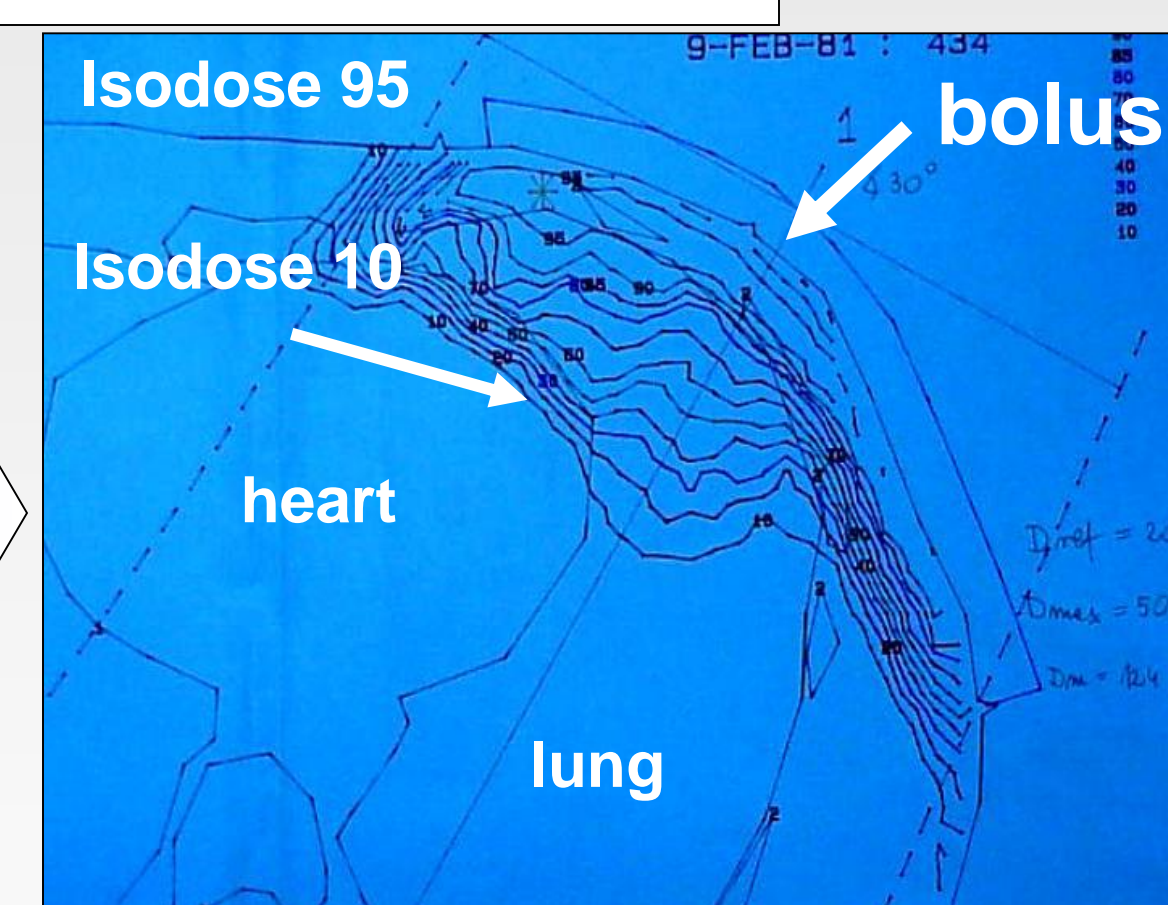


Post-irradiation with 9 MV e- at the Institut Curie (France) for Bialystok samples

Dose estimation



Dose reconstruction



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

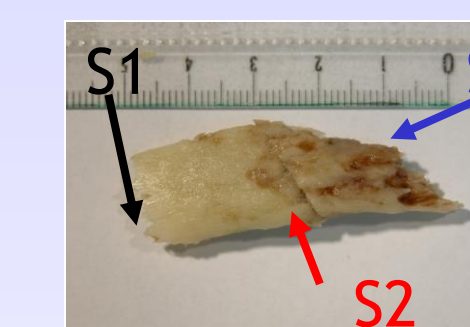
Good agreement between EPR results

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

Dose estimation

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

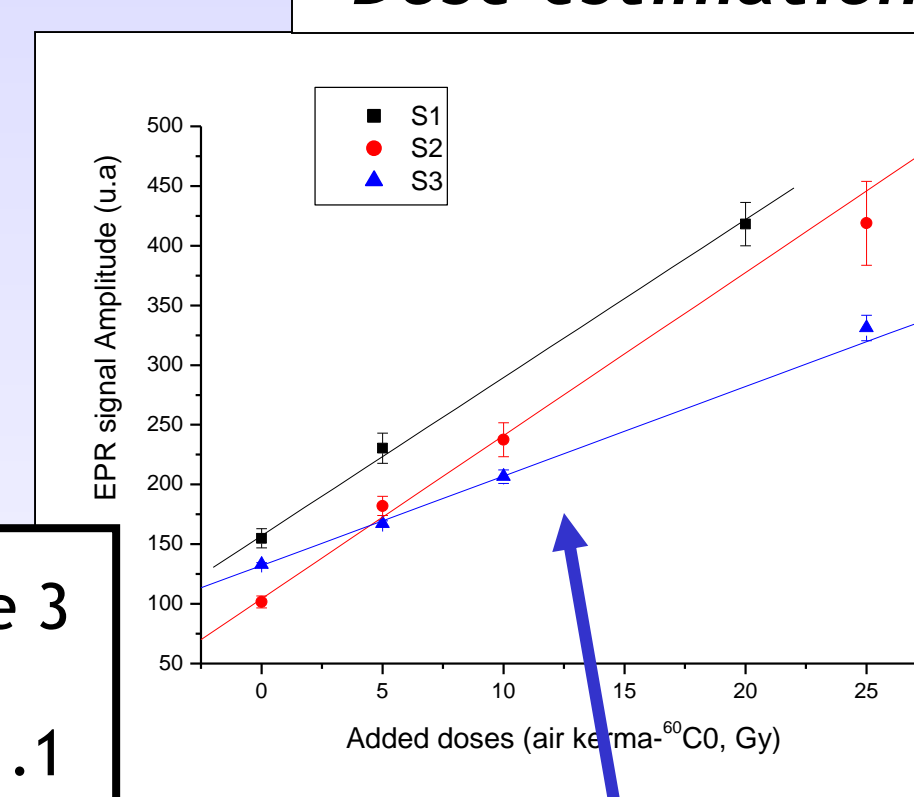


Dose results

	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

• 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