

Appendix:**References:**

- [1] In vivo dosimetry using a single diode for megavoltage photon beam radiotherapy: implementation and response characterization, doi: 10.1120/jacmp.v2i4.2598.
- [2] Comparison of p-type commercial electron diodes for in vivo dosimetry. <https://doi.org/10.1118/1.1630492>

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PS02.41 THE IMPORTANCE OF IODINE-125 PRODUCTION FOR USE IN BRACHYTHERAPY

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Introduction: According to the World Health Organization, 20 million new cases of cancer were reported worldwide in 2022 [1]. Iodine-125 seeds play a crucial role in a cancer treatment modality known as brachytherapy. The advantage of this treatment lies in the direct deposition of the iodine-125-containing seed into the tumor area, preserving healthy tissue. Iodine-125 is employed in the fabrication of these seeds. This radioisotope possesses low energy and a half-life of 59.4 days. Due to its characteristics, studies that facilitate the use of iodine-125 seeds are relevant, aiming to benefit a larger number of patients.

Materials & Methods: Iodine-125 has been produced in the IEA-R1 nuclear reactor at IPEN through the reaction $124\text{Xe} (n,\gamma) 125\text{Xe} \rightarrow 125\text{I}$. To ensure its clinical viability, it is crucial to guarantee an appropriate activity level. Therefore, samples are measured using a High Purity Germanium (HPGe) detector, and both spectrum acquisition and analysis are conducted through the Maestro Software.

Results: To maintain control over the produced iodine's activity, samples were periodically measured, with the resulting activities presented in Table 1. This monitoring is essential to establish the production of iodine-125, aiding in the determination of parameters required to calculate the doses of the seeds that will be delivered to hospitals and clinics.

Summary: Iodine-125 is produced in the IPEN nuclear reactor for the manufacturing of seeds intended for use in brachytherapy. The activity is verified using a HPGe detector.

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Appendix:

Measurement date	Activity (Bq)	SD (Bq)
04/07/2023	1139.81	5.82
19/09/2023	486.15	4.58
07/11/2023	241.69	1.10
20/12/2023	144.94	1.79
19/01/2024	96.34	0.60
05/02/2024	77.03	0.55

Table 1. Iodine-125 activity.

Reference:

- [1] WORLD HEALTH ORGANIZATION. Global Cancer Burden Growing, amidst mounting need for services. 2022.

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PS02.42 DETERMINING THE RADIATION EXPOSURE OF THE TESTICLES DURING INTERSTITIAL BRACHYTHERAPY OF THE PROSTATE USING MONTE-CARLO SIMULATION

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Introduction: Prostate cancer treatment via interstitial irradiation using the afterloading method offers an effective strategy to target tumors. However, the potential radiation exposure to peripheral organs remains underexplored. The aim of this work is therefore to estimate the radiation exposure of the testicles using a Monte-Carlo simulation.

Materials & Methods: The simulation was carried out with the user-code `egs_brachy` of EGSnrc software. Patient anatomy was modeled as a water-density cuboid (30 cm edge length), with organs similarly approximated. The prostate (3.8 cm × 2.8 cm × 3.4 cm) and testicles (4 cm × 4 cm × 4 cm) were simulated with a 13 cm center-to-center distance. The prostate model is evenly studded with 16 hollow needles and irradiated by a microSelectron-v2r ¹⁹²Iridium source. A standard average fraction dose of at least 10 Gy was prescribed for the prostate and a dose scaling factor was derived to determine absolute dose values.

Results: Results indicate an average testicular dose exposure of 0.1 Gy ± 0.0% statistical uncertainty with a total prostate dose of approximately 11 Gy at a 13 cm distance. Relative uncertainties for individual voxels peaked at ±0.46% for the testicles and ±0.07% for the prostate. The dose distribution in the testicle model is given in Fig. 1. Variations in distance led to corresponding dose adjustments, with distances of 10.16 cm and 15.4 cm resulting in testicular doses of 0.2 Gy ± 0.0% and 0.06 Gy ± 0.0%, respectively.

Summary: In conclusion, MC simulation enabled calculation of testicular peripheral dose during prostate brachytherapy. The computed dose exposure remained below the threshold for irreversible deterministic radiation damage across all examined distances.

Appendix: