

CALIBRATION OF $^{90}\text{Sr}+^{90}\text{Y}$ SOURCES USED FOR BETATHERAPY, USING A POSTAL KIT OF THERMOLUMINESCENT DOSIMETERS

Patrícia L. Antonio¹, Rogério M. V. Silva², Divanizia do Nascimento Souza² and Linda V.E. Caldas¹

¹ Instituto de Pesquisas Energéticas e Nucleares, Comissão Nacional de Energia Nuclear, IPEN-CNEN/SP

Av. Professor Lineu Prestes 2242, 05508-000, São Paulo, Brazil

² Departamento de Física, Universidade Federal de Sergipe, UFS

Av. Marechal Rondon s/n°, Jardim Rosa Elze, 49100-000, São Cristóvão, Sergipe, Brazil

patrilan@ipen.br, rmv.fisica@gmail.com, divanizi@ufs.br, lcaldas@ipen.br

1. Introduction

The need to calibrate $^{90}\text{Sr}+^{90}\text{Y}$ clinical applicators is recommended [1,2] and of great importance, because these sources can be very old, in addition to the necessity of the establishment of a quality control program for these sources, assuring that the sources are used correctly and that the treatments of the patients will bring effective results. As at Brazil the clinical applicators are still largely utilized in betatherapy procedures, a dosimetric system for calibration of these sources, using thermoluminescent dosimeters (TLD), was developed at IPEN [3] and applied in hospitals at São Paulo city, with the objective to be sent in future as a postal system to other Brazilian clinics and hospitals that use $^{90}\text{Sr}+^{90}\text{Y}$ applicators.

2. Objective

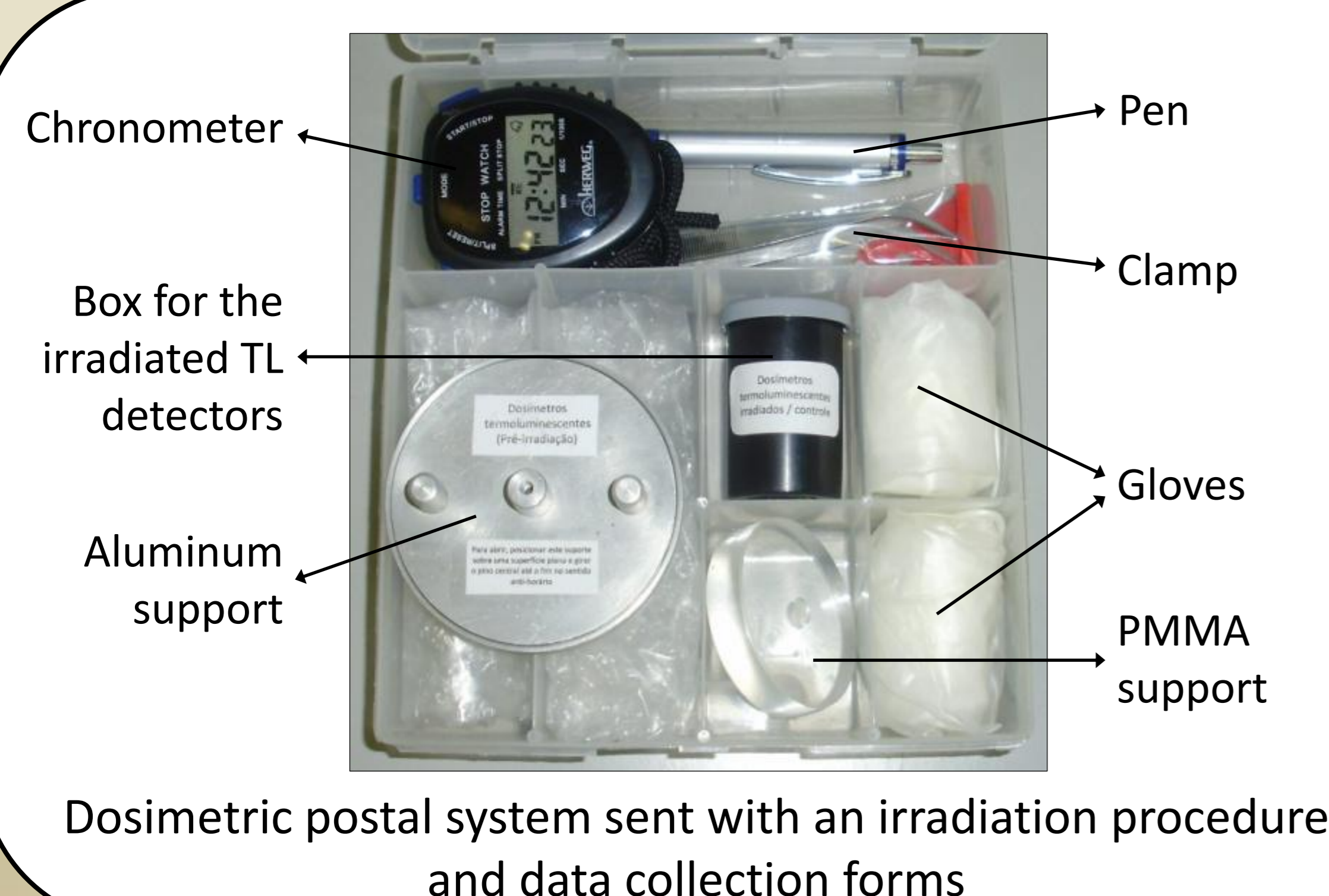
The objective of this work was to verify the usefulness of the dosimetric system as a postal kit, using the usual mail system, in the calibration of $^{90}\text{Sr}+^{90}\text{Y}$ clinical applicators.

3. Materials and Methods

- ✓ TL dosimeters: thin $\text{CaSO}_4:\text{Dy}$ → (diameter = 6.0 mm; thickness = 0.2 mm)
- ✓ Evaluation system: Harshaw TLD Reader, model 3500

Characteristics of the $^{90}\text{Sr}+^{90}\text{Y}$ clinical applicators from Amersham, utilized in this work

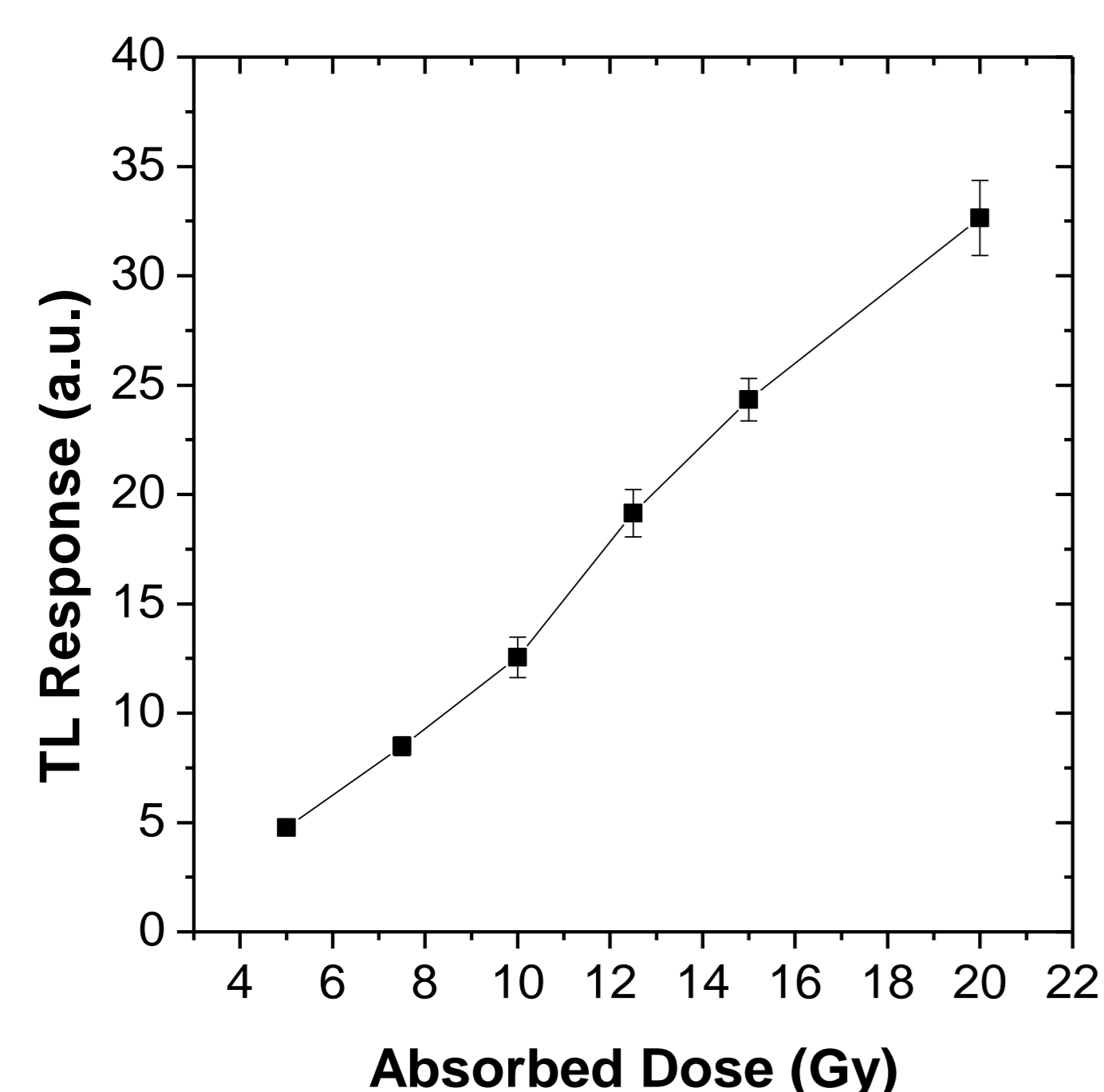
Source Number	Source	Model	Nominal Activity (MBq)	Absorbed Dose Rate (Gy/s)	Calibration Date
1	Dermatological	1520 – SIA5	74	0.018 ± 0.004	27.11.1973
2	Ophthalmic	928 – SIA6	370	0.027 ± 0.008	14.01.1992
3	Ophthalmic	1522 – SIA6	370	0.022 ± 0.017	27.11.1973



4. Results

1. Dose-Response Curve of NIST Applicator

- ✓ Reference source: $^{90}\text{Sr}+^{90}\text{Y}$ applicator (NIST) secondary standard



2. Irradiation of the TL dosimeters

- ✓ Dosimeters irradiated at the Federal University of Sergipe, Brazil
- ✓ Irradiation time of the applicators (according to the absorbed dose rates of the calibration certificates):
 - Applicator 1: 10 min
 - Applicator 2: 6 min
 - Applicator 3: 8 min

3. Determination of the Absorbed Dose Rates

Source Number	Absorbed Dose Rate (Gy/s) Certificate	Absorbed Dose Rate (Gy/s) This work	Difference (%)
1	0.0070 ± 0.0014	0.0076 ± 0.0015	-7.9
2	0.0167 ± 0.0050	0.0227 ± 0.0076	-26.4
3	0.0087 ± 0.0026	0.0189 ± 0.0059	-54.0

Applicator 1 → The results agree with previous calibration results [7]

Applicator 2 → The difference can be considered acceptable, because it is compatible with the uncertainty presented in the calibration certificate of the manufacturer (30%)

Applicator 3 → Very high difference (it will be calibrated again)

5. Conclusions

Three $^{90}\text{Sr}+^{90}\text{Y}$ clinical applicators (one dermatological and two ophthalmic) were calibrated using a dosimetric postal system. The result obtained for the dermatological applicator was acceptable (uncertainty presented in its certificate of 20%), and in relation to the ophthalmic applicators, the difference between the absorbed dose rates obtained and those from their calibration certificates were great, specially for the applicator 3, due to several factors (small error during the irradiation, the format of the source, and inhomogeneity of radioactive material on the source surface).

References

- [1] IAEA, International Atomic Energy Agency. Calibration of photon and beta ray sources used in brachytherapy. IAEA-TECDOC-1274, Vienna (2002).
- [2] Soares, C. G. Comparison of NIST and manufacturer calibrations of $^{90}\text{Sr}+^{90}\text{Y}$ ophthalmic applicators. Med. Phys. 22 (9), 1487-1493 (1995).
- [3] Antonio, P. L.; Caldas, L. V. E. Application of a dosimetric system for calibration of $^{90}\text{Sr}+^{90}\text{Y}$ sources used in brachytherapy. Radiat. Meas. 46, 2025-2027 (2011).