Transitioning from OSLDs to TLDs for In-Vivo Dosimetry in Total Skin Electron Therapy: A Clinical Perspective

Ashok Tiwari, Colin Huang, Sook Kien Ng, Judith Rivera, David Campos, Oluwaseyi Oderinde, Christopher Njeh, and Yong Yue

Indiana University School of Medicine, Indianapolis, IN

4/27/2024

Outline

- Background and introduction
  - Thermoluminescent dosimeters and optically stimulated luminescent dosimeters for in-vivo dosimetry
- Methods
  - Total skin electron therapy, modified stanford technique
  - IVD with TLDs and OSLDs
- Results
- Conclusion and future works

Properties of TLDs and OSLDs

Dosimeter	Accuracy	Composition	Advantages	Disadvantages
TLD	~3%	LiF:Mg,Ti (TLD100)	• Energy independent (>100 keV) • Reusable	• Read out once • Requires significant time to read out • Supralinear response with reuse
OSLD	~3%	Al_2O_3:C	• Multiple readouts • Rapid read out, high efficiency • Reusable • Persistent dose record	• Higher Z_{eff} than TLDs (8.31 vs 11.3) • Stronger energy dependance than TLDs

Pictures of TLDs and OSLDs

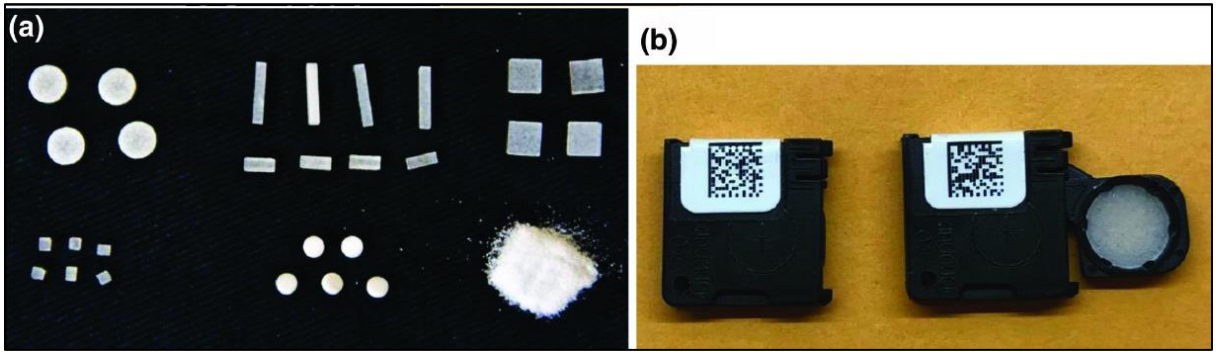

Fig: (a) TLDs are available in the form of disks, rods, chips, microcubes, and powder (b) OSLD as a nanoDot™ disk. Image is taken from TG-191.

In-Vivo dosimetry (IVD)

- IVD is a technique used to directly measure the radiation dose received by a patient's body during treatment.
- For in-vivo monitoring of the radiation therapy delivery, luminescent dosimeters have shown reasonable accuracy.
- Until recently, OSLDs have been the great choice because of the faster dose readout in clinical dose monitoring.
- The FDA very recently (Sep 2023) recalled nanodots and nanodot readers because some nanoDots may potentially fall outside the specified range of ±5.5% accuracy.*
- In our department, we recently transitioned to TLDs for IVD for total skin electron therapy.

*https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfres/res.cfm?id=202745

Total Skin Electron Therapy

- TSET is an effective treatment option for a patient with mycosis fungoides.
- Prescription: 16 Gy in 8 fractions, at 8 mm depth with 6 MeV electrons
- The patient was positioned at 450 cm from the radiation source and an acrylic attenuator was employed.
- TLDs and OSLDs were placed adjacent to each other at 14 anatomical sites during the first fraction for IVD.
- TLD100 were obtained from the University of Wisconsin-Madison Radiation Calibration Laboratory.
- TLDs were subsequently sent to Wisconsin for reading, while OSLD were read using the microSTARii reader.

IVD with TLDs and OSLDs

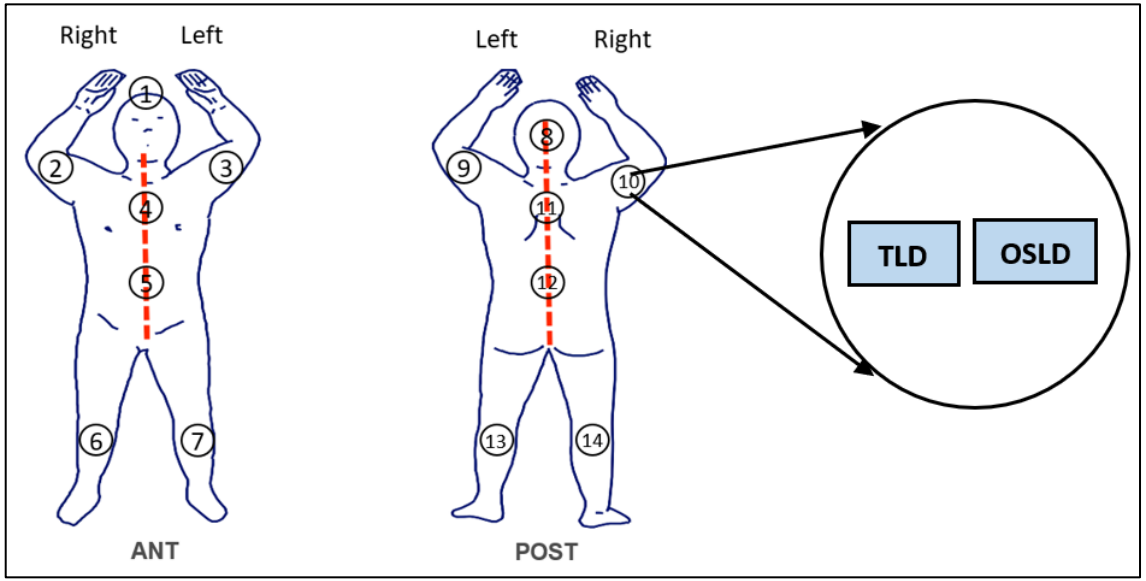

Fig: Positions of the TLDs and OSLDs on the patient's body surface. The patient was treated using a modified Stanford technique.

Results: TLD vs OSLD

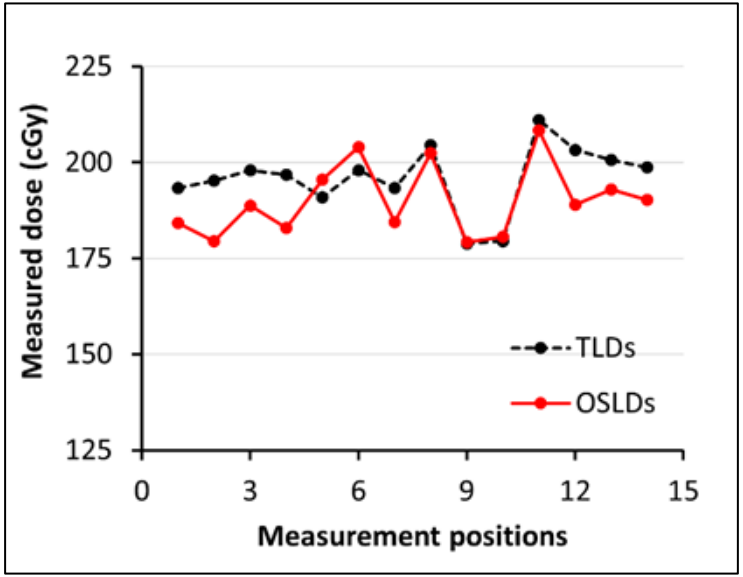

Fig: Absorbed dose responses of TLD and OSLD.

- The TLD measurements exhibited an average variation of (-2.08±4.37)%, ranging between -10.57% and 5.50%.
- OSLD measurements showed a larger average variation of (-4.93±4.72)%, ranging from -10.43% to 4.16%.
- Both measurements indicate a slight underdosing compared to the prescribed dose at a depth of 8 mm.

Conclusion and future works

- Our measurements suggest that TLDs offer superior dosimetric accuracy compared to OSLDs in TSET.
- Utilizing TLDs for IVD is feasible and reliable, even without direct access to a TLD reader, supporting their broader adoption for IVD in clinical settings.
- Future work will extend these findings by exploring alternative dosimeters, such as radiochromic films and MOSFET for IVD.