Dosimetric inefficacy of non-tissue equivalent commercial optically stimulated luminescence dosimeter for in vivo dosimetry of out of radiation field exit dose measurements in EBRT

Gourav Kumar Jain¹, Arun Chougule², Rajni Verma²

¹Department of Radiation Oncology, MG Medical College & Hospital, Jaipur, India
²Department of Radiological Physics, SMS Medical College & Hospital, Jaipur, India

(E-mail: gourav108@gmail.com)
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Aim & Objectives


✓ TLD, OSLD, MOSFET are frequently used dosimeters to serve desired purpose.

• The present study designed to evaluate entrance and exit doses for out of the radiation field in EBRT.

• The primary aim of this study was to investigate the efficiency of non tissue equivalent (NTE) commercially available OSLD for in vivo dosimetry of out of the radiation field dose measurements in EBRT.

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Materials & methods

• All the measurements were performed in 10 head and neck patients (age range, 35–46 years; mean, 44 years) treated with two parallel opposed lateral fields on Bhabhatron-II TAW Telecolbalt unit (Panacea Medical Technologies, Bengaluru, India) using source to surface distance (SSD) technique.
• The OSLDs used in this study were from Landauer Inc., USA, Al$_2$O$_3$:C nanoDot™ dosimeter (10 X 10 X 2 mm).
• TL dosimeters were from Nucleonics India Pvt. Ltd., LiF:Mg,Ti chips (3.2 X 3.2 X 0.89 mm).
Materials & methods

OSL Reader System, Landauer Inc., US

TL Reader System, Nucleonix systems, India

Bhabhatron-II TAW Telecobalt unit, India

LiF: Mg, Ti chips - TLD

OSL nanoDot from Landauer with Large plastic holder

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• The OSL nanoDot™ were placed at the level of the eyes of the patient for a single right lateral treatment field only. This methodology provided the set up to assess out of field entrance and exit radiation dose to eye.

• TLD chips were also placed exactly in the identical places in the next treatment fraction of same patient.

• The physical data measured were separation distance at the level of eye, distance between radiation field edge and ipsilateral right eye at SSD. The distances were calculated for radiation beam exit from isocenter at the exit surface of the patient.
Observations

• The distance between radiation field edge and ipsilateral eye at SSD was measured in the range of 2.0–4.0 cm with mean 3.3 cm.

• It was obvious to observe with theoretical calculations using radiation divergence property that the primary radiation beam was not passing through contralateral eye.

• The contralateral eye was away from the exit of edge of radiation beam in all the cases and distances were found in the range of 0.5cm-2.8cm.
Pictorial representation

Central Axis

Radiation Beam

Entrance

11cm-15cm

Exit

$D_{\text{entrance}}$

2.0cm–4.0cm

$D_{\text{exit}}$

0.5cm-2.8cm

7.0cm-8.5cm

8.0cm-9.5cm

Radiation Beam

Entrance

Exit

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Results

• When the doses were analyzed for non tissue equivalent OSL nanoDot™ and it was surprising to note that the exit dose to contralateral eye ($D_{exit}$) were measured 1.2 to 2.0 times higher than the entrance dose to ipsilateral eye ($D_{entrance}$).

• To investigate this over-response, the doses were measured with tissue equivalent TLD-100 chips in the identical conditions. It was found that $D_{exit}$ were measured 15% to 20% less than $D_{entrance}$. 

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Discussion

• The possible cause for this over-response in NTE dosimeter (OSLD) is increase in the intensity of secondary electrons and low energy scattered photons reaching to dosimeter at the exit surface of the patient during out of field measurements.
• The results of this study suggested that non tissue equivalent OSL nanoDot™ were not the dosimeter of choice for out of field exit dose measurements.
• One should be precautionous to use non tissue equivalent OSL nanoDot™ for out of field exit dose measurements. Further study needs to be performed to deal this over-response using either appropriate correction factors or build up caps.
Conclusion

• The non tissue equivalent dosimeters were not the promising dosimeters for out of field exit dose measurements.

• The research outputs of this study may be helpful for the selection of the appropriate in vivo dosimeter suitable for clinical use for out of the radiation field dose measurement conditions in radiotherapy.
Thank you!