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Small Beam Dosimetry by Using Optically Stimulated Luminescent (OSL) Dosimeters in High Energy Photons and Electrons

Mohd Fahmi Mohd Yusof[1], Nur Amirah Shariff[1], Nur Sajidah Muhammad Fauzi[1], Ahmad Bazlie Abdul Kadirl[1], Reduan Abdullah[2]

[1]School of Health Sciences, Universiti Sains Malaysia, 16150 Kelantan, Malaysia

[2]Health Physics and Secondary Standard Dosimetric Laboratory, Malaysian Nuclear Agency, 43000 Bangi, Selangor, Malaysia

[3]Nuclear Medicine, Radiotherapy and Oncology Department, Hospital Universiti Sains Malaysia, 11800 Penang, Malaysia

ABSTRACT

This study measured the dose in small beam of high energy photons and electrons by using Optically Stimulated Luminescence Dosimeter (OSL dosimeters). The percentage depth dose (PDD) at 6 and 10 MV as well as 9 and 12 MeV electrons were measured and compared to those in ionization chamber and EBT3 film dosimeter at 3 cm x 3 cm field sizes. The result showed good agreement of PDD curve of the OSL dosimeters compared to ionization chambers and EBT 3 film dosimeters for within 9 and 11% variation at 6 and 10 MV photons respectively. The result also showed good agreement of PDD curve of the OSL dosimeters compared to ionization chambers and EBT 3 film dosimeters for within 10.3 and 3.85% variation at 9 and 12 MV electrons respectively. Further statistical evaluation by using paired sample t-test value show that there is no significant difference between the dosimetric readings in OSL dosimeters to ionization chambers and EBT 3 film dosimeters for both photons and electrons. The overall results indicated the feasibility of OSL dosimeters for small beam dosimetries at high energy photons and electrons in radiotherapy.

CONTACT

Dr. Mohd Fahmi Mohd Yusof

School of Health Sciences
Universiti Sains Malaysia
16150 Kota Bharu, Kelantan
mfahmi@usm.my
+609-7677576 (O)
+609-7677515 (F)

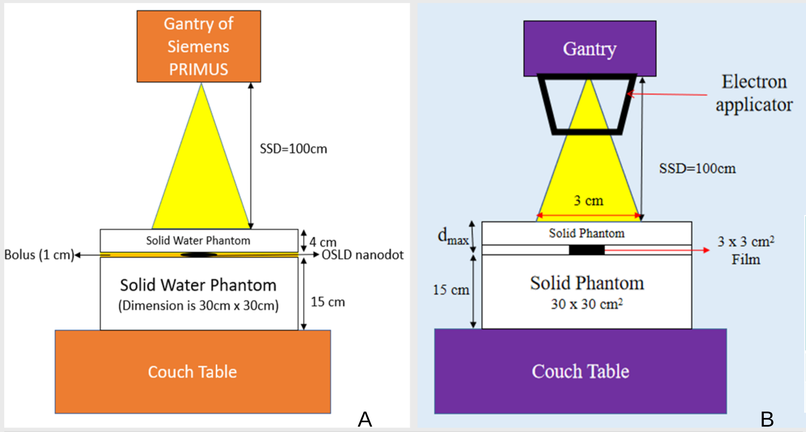
INTRODUCTION

The partial occlusion of the primary photons source by the collimating devices on the beam axis occur when the size of collimating output beam of the linear accelerator is approximately same or smaller than the source size as viewed from the detector and it means that only a portion of the source is seen by the dosimeter. Hence, a lower beam output will produce on the beam axis compared to field sizes where the detector sees the whole source. Moreover, the partial occlusion of the primary photons source also leads to error in determining the field size from the full width at half maximum (FWHM) because of FWHM is larger than the actual field size.

Previous works indicated the feasibilities of OSL dosimeters for various dosimetry works in medical physics and radiation monitoring. The small size of OSL dosimeters are postulated to give an advantage on the small beam dosimetry.

The percentage depth dose (PDD) is the most versatile and fundamental method to determine the attenuation and dosimetric properties of any dosimeters and irradiation techniques in radiotherapy. The PDD would be the main indicator to determine the dosimetric properties of OSL dosimeters at small beams in comparison to other common dosimeters such as ionization chambers and film dosimeters.

METHODOLOGY

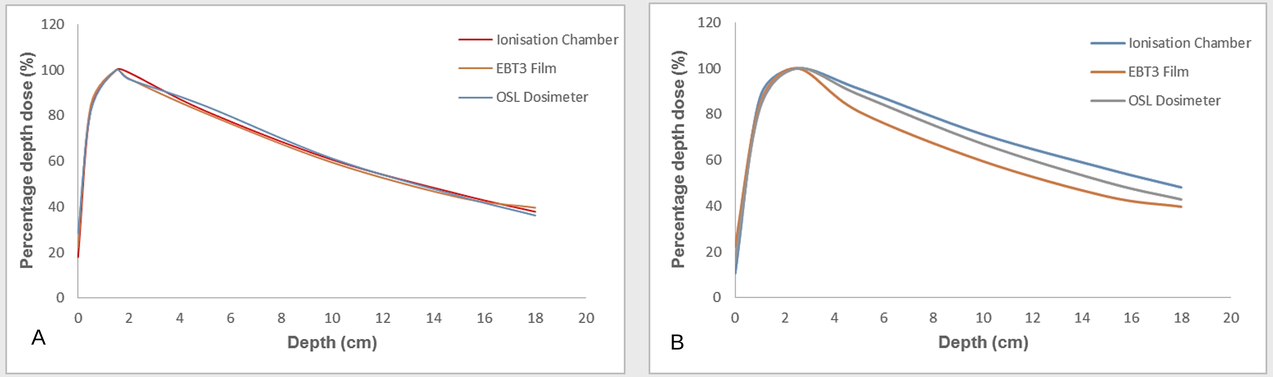


The OSL Dosimeters were irradiated at photons of 6 and 10 MV and electrons of 9 and 12 MeV photons at calibration conditions according to IAEA TRS 398.

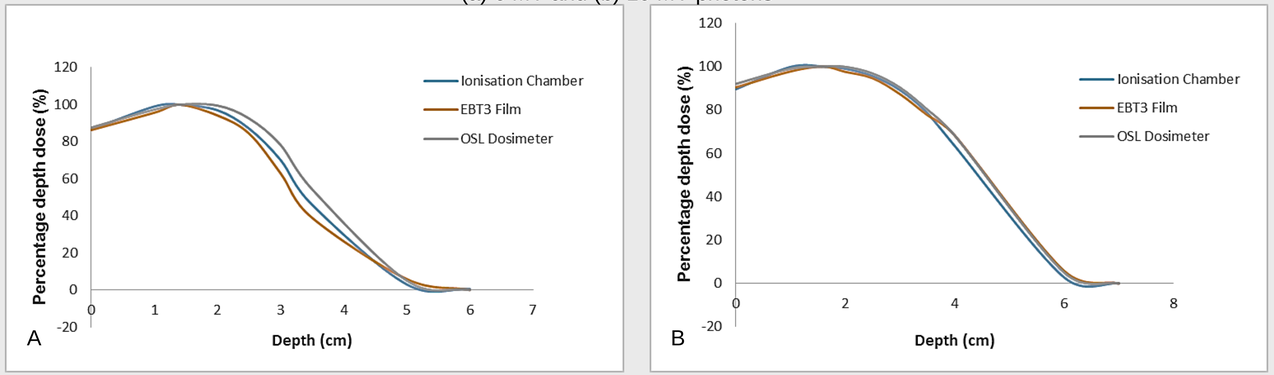
The small field size of 3 x 3 cm was achieved by using the multileaf collimators for photons (a) and applicator for electrons (b)

The PDD curves were plotted and compared to those on ionization chamber and EBT3 film dosimeter

RESULTS



Percentage depth dose curve of OSL dosimeters at 3 x 3 cm field size in comparison to ionization chamber and EBT3 film at (a) 6 MV and (b) 10 MV photons



Percentage depth dose curve of OSL dosimeters at 3 x 3 cm field size in comparison to ionization chamber and EBT3 film at (a) 9 MeV and (b) 12 MeV electrons

Energy	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of Differences				
				Lower	Upper			
6 MV	0.9187	4.12767	1.4593	-2.53207	4.36957	0.630	7	0.549
10 MV	-2.38571	4.02189	1.5201	-6.10535	1.33392	-1.569	6	0.168

Energy	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of Differences				
				Lower	Upper			
9 MeV	0.67238	3.07102	1.0857	-1.89507	3.23982	0.619	7	0.555
12 MeV	-2.96000	7.59024	2.8688	-9.97980	4.05980	-1.032	6	0.342

CONCLUSIONS

The measurement of PDD showed good agreement of PDD curve of the OSL dosimeters to other common dosimetry of ionization chambers and EBT 3 film dosimeters in both high energy photons and 10 electrons. There were no significant difference between OSL dosimeters to ionization chambers and EBT 3 film in all experimented energies of photons and electrons. The overall results indicated the suitability of OSL dosimeter for dosimetry works involving clinical photons in small beam radiotherapy.