

Purpose

To compare the dose measurement accuracy of three commonly used *in vivo* dosimeters in clinic for patients receiving total body irradiation. Three types of dosimeters selected for this study are TLDs, MOSFETs & OSLDs.

Materials and Methods

Three types of dosimeters were considered for this study, LiF Thermoluminescent Dosimeters, Modified Field Effect Transistors(MOSFET - Thomson&Nielsen TN-502RD) and Optically Stimulated Luminescence Dosimeters(OSLD - Landuer's 2% screened nanoDOTs). All dosimeters were calibrated under full buildup condition at 100cm SSD, $d_{max} = 3.4\text{cm}$ for 18MV photon energy and appropriate correction factors were applied for TBI treatment condition. This study is performed on a 30x30x22cm solidwater phantom and a rando phantom at the TBI treatment distance. The separations at different locations for the phantoms were measured and MUs were calculated to deliver 100cGy at the midplane. Dosimeters with buildup caps were placed on the entrance side of the phantom to measure d_{max} dose. Each type of dosimeters were irradiated at five locations in the rando phantom under the same treatment setup. The reproducibility of the dose measurements was verified by performing measurements in solidwater phantom. Ten TBI cases, which were monitored using each dosimeter type were selected and tabulated the percentage difference of measured to expected dose for five different locations.

Results

The reproducibility of dose measurement using TLDs, MOSFETs and OSLDs were 118.3cGy +/- 2.7%(1 σ), 118.3cGy +/-2.1%(1 σ) and 118.3cGy +/- 1.8%(1 σ) respectively after 10 consecutive measurements in solidwater phantom (Table 1). From rando phantom measurements, maximum percentage variation of the mean value of the measured dose to expected dose with 1 σ values are TLDs (1.4 +/- 1.4), MOSFETs (3.9+/- 2.2) and OSLDs (1.6 +/- 1.8) (Table 2). Percentage difference of the measured dose to expected dose for 10 clinical cases were TLDs (2.3+/- 2.9), MOSFETs (3.7+/- 4.9) and OSLDs (1.8+/- 2.9%) (Table 3).

Conclusions

Measured dose were within/or close to +/-5% tolerance level for all three *in vivo* dosimeters. OSLDs(2% screened nanoDOTs) can give better accuracy, reproducibility with an added advantage of ease of use and placement on the patients.

Dosimeter	Entrance Dose
TLDs	118.3cGy +/- 2.7%
MOSFETs	118.3cGy +/- 2.1%
OSLDs	118.3cGy +/- 1.8%

Table 1: Verified the response reproducibility of TLDs, MOSFETs and OSLDs using 30x30x22cm solidwater phantom by placing the dosimeters with buildup caps on the entrance side. Lucite buildup caps were used for TLDs and OSLDs and brass buildup caps for the MOSFETs dosimeters. Measurements were done under the TBI setup at a treatment distance of 562cm to deliver 100cGy at midplane depth of 11cm. Measurements were cross checked with Ionchamber placed at the midplane depth. This table provides measured dose (mean) +/- 1 standard deviation from ten consecutive measurements performed for each dosimeter type.

Dosimeter	Head	Umbilicus	Pelvis	Knee	Ankle
TLDs	1.2% +/- 1.2	2.0 % +/- 1.3	2.0 % +/- 2.6	1.8 % +/- 5.4	2.3% +/- 2.9
MOSFETs	1.6% +/- 3.8	1.9 % +/- 5.0	1.8 % +/- 5.9	2.4 % +/- 4	3.7% +/- 4.9
OSLDs	1.8% +/- 2.9	1.5 % +/- 3.3	1.7 % +/- 3.1	0.7 % +/- 3.3	0.6% +/- 3.4

Table 3: TBI cases selected for this study were treated by AP/PA technique at an extended SSD of 562cm. In vivo dosimetry for five locations such as head, umbilicus, pelvis, knee and ankle using each dosimeter type were compared. Expected dose for each location for all the selected patients were calculated using TBI excel spread sheet. The data is tabulated in terms of the percent variation of the measured dose (mean value) from the expected dose with value of 1 standard deviation.

Dosimeter	Location#1(cGy)	Location#2(cGy)	Location#3(cGy)	Location#4(cGy)	Location#5(cGy)
TLDs	114.7 +/- 2.2 [0.7%]	116 +/- 2.2 [1.3%]	112.7+/-1.4 [1.4%]	113.5 +/- 1.4 [0.7%]	115.7 +/- 1.0[0.9%]
MOSFETs	117.2 +/- 2.1 [3.0%]	115.5 +/- 1.6[0.9%]	115.1+/-2.4 [0.7%]	118.7 +/- 2.2 [3.9%]	116.6 +/- 1.5 [1.8%]
OSLDs	115.7 +/- 1.5 [1.6%]	116 +/- 1.8 [1.3%]	114.8 +/- 1.5 [0.5%]	115.7 +/- 0.8 [1.2%]	115.6 +/- 1.8 [1.0%]

Table 2: A set of measurements were done on a rando phantom by placing the dosimeters at five locations on the entrance side. Three dosimeters were used for each locations and irradiated to deliver 100cGy to the midplane. Compared the measured entrance dose at d_{max} to the expected dose, which was calculated using the separation at each of the locations. Dose for each location was compared and tabulated using mean dose with 1 standard deviation. Percentage variation of the mean value of measured to expected dose at different locations are in parenthesis