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Validation of entrance surface air kerma of MTS-N (LiF: Mg, Ti) chips with reference ionisation chamber using kilovoltage X-ray machine for patient dosimetry

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ABSTRACT

Background. The use of ionisation chamber and thermoluminescent dosimeter (TLD) for patient dosimetry are well established.

Aim and objectives. The aim was to compare the entrance surface air kerma (ESAK) between MTS-N (LiF: Mg, Ti) chips and ionisation chamber by exposing them to same dose. The purpose is to use the TL chips as a tool for patient dosimetry/audit in diagnostic radiology. In addition, homogeneity and element correction factor (ECF) of the selected chips were determined.

Material and methods. TL chips were annealed at 400°c for one hour and allowed to cool and were further heated to a temperature of 100°c for another two hour usings a TLD Furnace Type LAB-01/400. The calibrated DCT-10mm ionisation chamber was positioned on a plastic container filled with water, 10cm thick at source to image distance (SID) of 1m for a 10 × 10cm^2 field size. The same procedure was used for the TL chips, which were carefully placed in a transparent nylon on the plastic container as well. Exposures were made to 10mGy. MagicMax software was used to display the ion-chamber ESAK. A RadPro Cube 400 manual TLD reader was used to determine corresponding TL signal and predetermined calibration factor (CF). The unexposed chips were subtracted from exposed ones and were multiplied with the appropriate backscatter factor (BSF) to determine TL ESAK.

Results. There was good exposure reproducibility from the X-ray unit, with coefficient of variation (CV) of 0.12%. The maximum uniformity index of the chips was 24.18%, which was below the 30% limit. The ECF for the ten (10) selected TL chips ranged from 0.9-1.1, which was within accepted limit (0.8-1.2). The maximum deviation of the TL chips to the ion-chamber was -9%, which was < ± 10%, while 70% of the % deviation were < ± 5%. The mean dose of TL chips was 10.02±0.48mGy, with accuracy of 0.2%.

Conclusion. The MTS-N (LiF: Mg, Ti) chips from this study yielded positive results when compared to ionisation chamber measurement at low dose.

Keywords thermoluminescent dosimeter, calibration, cesium-137, coefficient of determination, backscatter factor

LAY ABSTRACT

A study was done using different ways of working out radiation dose.

INTRODUCTION

Major standard quantities used for assessing patient dose in radiographic examinations are the entrance surface air kerma (ESAK), radiation output of the X-ray tube and dose area product (DAP) meter.[1-3] ESAK can be measured directly using thermoluminescent dosimeters (TLDs); more recently optically stimulated luminescence dosimeters (OSLDs) have been used for the same purpose but mostly in radiotherapy because of its good sensitivity at higher doses.[4-6] Most new radiographic systems have DAP meters for patient dose assessment.[7] The energy response of TLDs, particularly LiF: Mg, Ti have been studied.[8] The basic principle of operations of TLDs involves the absorption of energy by the TL elements from ionising radiation, which may be X-rays, gamma rays, neutrons particles, alpha and beta particles, among others. The second stage is the relaxation of the system back to equilibrium by energy release such as light with the help of a thermal stimulator.[9,10] The most commonly used TLDs for medical applications are the LiF: Mg, Ti, LiF: Mg, Cu, P and $Li_2B_4O_7$: Mn, because of their tissue equivalence. Other luminescence dosimeters, for example, $CaSO_4$: Dy, Al_2O_3: C and CaF_2: Mn, have been used because of their high sensitivity. Most TLDs are available in various forms (e.g. powder, chips, rods and ribbons).[11-14]

This study used MTS-N (LiF: Mg, Ti), which has neutral abundance of lithium (Li). Before they are used for clinical purposes, the nature of their performance characteristics needs to be verified to rule out possible errors. General use of TLDs requires that they are first annealed to erase residual energy using an annealing oven at known temperatures, after which they are exposed to ionising radiation, before they are read using a TLD reader. Usually, the measurement chamber of the reader contains a PMT tube module, heating unit, exchangeable filter unit, and a nitrogen gas supply unit. Once the elements are heated through the heating unit, trapped energy is released in the form of light, from which a photo-multiplier tube (PMT) does the light amplification, before they are converted into electrical signal.[15,16]

The basic principle of ionisation chamber involves the system detecting liberated electron charge when X-ray photons or other ionising particles interact within the system, thereby ionising the gas within the chamber. Usually, the chamber needs a high positive voltage applied at the collecting anode to attract the liberated electrons. The electron charge is collected and used to determine exposure, which is expressed in coulombs per kilogram (C/kg) or grays (Gy). Several application software have recently been introduced, which can be connected to a PC to measure a range of quantities in a single exposure.[17] To buttress this, MagicMax software was used and was connected to a MagicMax universal basic unit and a USB connector to link the detector (DCT-10mm ion-chamber).[18]

The purpose of this study was to compare dose between an ionisation chamber and MTS-N (LiF: Mg, Ti) chips, when both detectors are exposed to 10mGy, under the same conditions. The objectives were: to determine the exposure reproducibility of the unit, homogeneity and element correction factors (ECFs) of the chips; and to evaluate the percentage deviation in dose between both detectors. This study presents the calibration factor of the MTS-N (LiF: Mg, Ti) chips, which were used to determine the TL doses.

MATERIALS AND METHODS

TL homogeneity

TL homogeneity was the first step that was carried out in this study. A total of ten MTS-N (LiF: Mg, Ti) chips were selected from a group of one hundred and twenty (120) TL chips with similar properties (Figure 1). The selected chips were annealed, in a TLD furnace type LAB-01/400 (RadPro International), at a temperature of 400°C for one hour and then cooled to room temperature. Then subjected to 100°C for two hours to erase residual trapped energy (Figure 2). The chips were later exposed to 10mGy to test their homogeneity. A RadPro TLD Cube 400 manual reader was used to determine the corresponding TL counts (Figure 3). To complete this process, the chips were later re-annealed and read to determine zero/background TL counts. The homogeneity or uniformity index (Δ_{max}) of individual chips was given as[19]:

$$\Delta_{max} = \frac{(M\text{-}M_o)_{max} - (M\text{-}M_o)_{min}}{(M\text{-}M_o)_{min}} \times 100 \leq 30\%$$

Where:
M_o is the background reading
M is the TL response value
$(M\text{-}M_o)_{max}$ is the maximum value of TL reading corrected for background
$(M\text{-}M_o)_{min}$ is the minimum value of TL reading corrected for background.

The International Electrotechnical Committee (IEC) has recommended that the uniformity index of individual chips must be ≤ 30%.

Calibration factor for MTS-N (LiF: Mg, Ti) with Cs-137

Prior to this study, the calibration factor for the TL chips was carried out in a secondary standard dosimetry laboratory (SSDL) using a cesium (Cs)-137 source. The line graph, which is given as $D = 5.969 \times 10^{-6}$ (*TL count*) - 3.492, was used to determine dose. Depending on the purpose it could be used to estimate personal equivalent

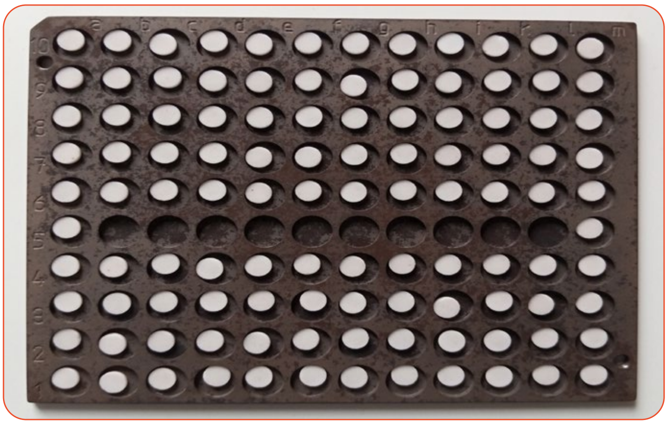

Figure 1. Storage dish from where 10 chips were selected.

Figure 2. TLD furnace type LAB-01/400.

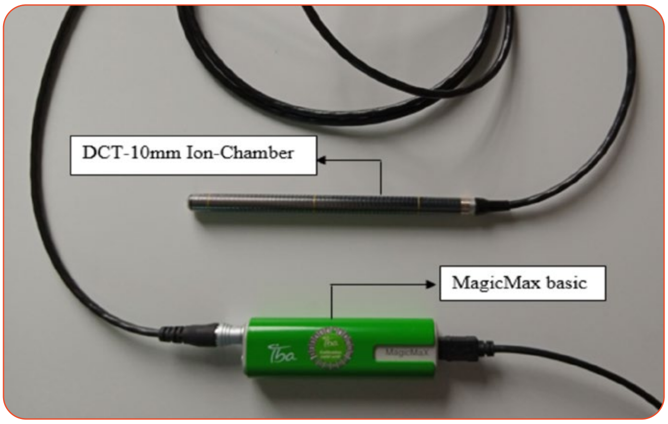

Figure 3. The DCT-10mm ionization chamber and MagicMax basic unit.

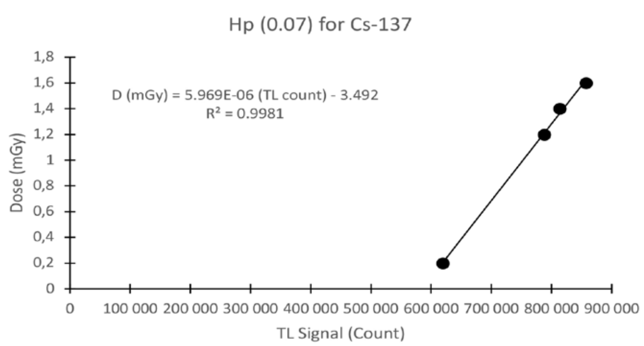

Figure 4. Dose (mGy) against TL signal (Count) for Hp (0.07) for Cs-137.

dose or patient dose. Both approaches would require some correction factor. In this case it was used for patient dosimetry, which required BSF (Figure 4).

Ionisation chamber exposure reproducibility, set-up and measurement

Dose response from the calibrated DCT-10mm ionisation chamber (IBA Dosimetry, Germany), with a measuring range of 40-150kV, a dose range of 0.01-15Gy, with uncertainty < 5%, was used alongside a MagicMax basic unit. It has the capacity to measure dose (in µGy, mGy and Gy) and other quantities simultaneously (Figure 5). The respective exposure reproducibility of the X-ray unit and ionisation chamber was determined at a constant kVp and mAs to determine the acceptability of the unit for this study. The ionization chamber was placed on a rectangular plastic, 10cm thick and filled with water. It was positioned at a source to image distance (SID) of 100cm, covering a beam area of 10 by 10cm^2 (Figure 6). Exposure factor was 99 kV on 32 mAs. Four exposures were made to achieve approximately 10mGy.

Figure 5. MagicMax software.

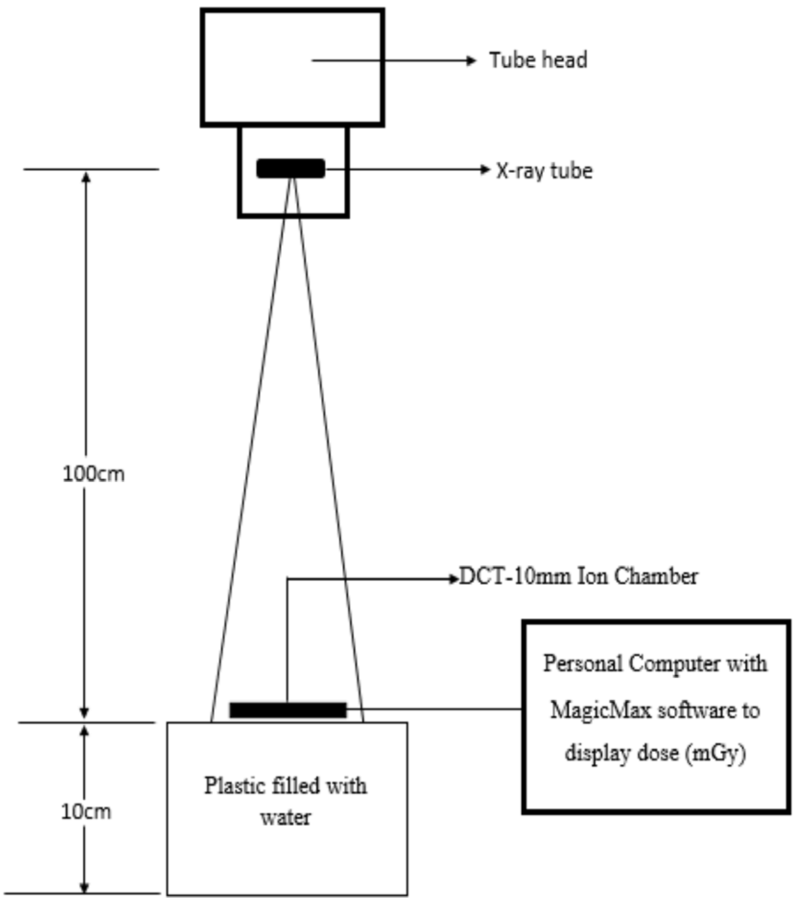

Figure 6. Set-up for dose measurement with an X-ray machine.

TL measurement

After exposure of the TL chips using the parameter as mentioned above, a RadPro Cube 400 manual TLD reader (Freiberg Instruments GmbH, Germany) was used to determine corresponding TL count for the chips. Obtained TL counts were used to determine the element correction factor (ECF) to see if they are within accepted range. The equation of the calibration factor was then used to determine corresponding dose. A backscatter factor (BSF) was applied, which is given as[20]:

$$ESAK = D_{TL\ chips} \times BSF$$

RESULTS

Exposure reproducibility between the X-ray unit and the DCT-10mm ionisation chamber for 10 readings resulted in a coefficient variation of 0.0012; the deviation of the mean was -0.25%, with the uncertainty of chamber < 1% against the manufacturer's which was < 5%.

The uniformity index, which defines the homogeneity of individual TL chips, was below 30%, which means they were all accepted for use in this study. The range of 10 selected chips was 1.8-24.18%. The maximum value of TL reading corrected for background $(M\text{-}M_o)_{max}$ was 1312168 count, while the minimum value of TL reading corrected for background $(M\text{-}M_o)_{min}$ was 1056657 count (Table 1).

The ECF for TL1-TL10, exposed to 10mGy was 1.1, 1.0, 0.9, 1.0, 0.9, 1.0, 1.0, 1.0, 1.0, and 1.0 respectively, with maximum ECF noticed in TL1 (1.1) (Table 2).

The % deviation, between dose measurement with DCT-10mm ionization chamber and MTS-N (LiF: Mg, Ti) chips, after the application of BSF ranged from (-9) to 7%. The mean dose of TL chips was 10.02±0.48mGy, with accuracy of 0.2%. The highest deviation was noticed in TL1, which was below < ±10% (Table 3).

DISCUSSION

According to Safety Code 35 (S.C. 35), the coefficient of variation (CV) of any ten consecutive radiation irradiation measurements should be no greater than 0.05, and each irradiation measurements should be within 15% of the mean value of the ten measurements. On the other hand, the Healing Arts Radiation Protection Act (HARP) states: the coefficient of variation of any ten consecutive radiation measurements should be no greater than 0.08, and each of the ten irradiation measurements should be within 20% of the mean value of the ten measurements. Since the obtained values from X-ray unit resulted in a CV of 0.0012, it can be concluded that the X-ray unit was within acceptable limits. Also, as calculated above, each of the ten irradiation measurements were well within 15% and 20% of the mean value of the ten measurements; the x-ray unit also passed this criterion.[21-23]

The line graph for Cs-137 produced a coefficient of determination of (R^2) of 0.9981. This was comparable to several studies that used LiF: Mg, Ti chips.[24-29] The use of the calibration factor and the TL counts to determine ESAK may not reflect the actual dose; the compensation for BSF was necessary because of its contribution to patient dose in diagnostic radiology. For low-energy photons kerma is numerically approximately the same as absorbed dose. For higher-energy photons, kerma is larger than absorbed dose because some highly energetic secondary electrons and X-rays may escape the region of interest before depositing their energy.[10]

The ECF obtained in this study ranged from 0.9-1.1 which was within the 20% (0.8-1.2) range proposed by Plato and Miklos[30] and that of Kong and Kim (0.7-1.5).[31] The coefficient of variation (CV), in terms of the ECF from the 10 selected chips in this study, was 5.73%. This was in line with a study by Sabar et al[24], where 10% (0.9-1.1) was proposed to be good. Although, Kong and Kim[3] proposed a CV of 5% for practical use. In this case, if TL3 and TL5 were removed from the 10 selected chips, a CV of 3.5% would be achieved, which would be in line with the results obtained by Kong and Kim.

The homogeneities of the TL chips, also known as the uniformity index, were verified and were found to be below the 30% recommended limit.[9,19] This tool is important and should be carried out before determining TL calibration factor as it helps sieve out non-homogenous TL chips.

The mean dose for the MTS-N (LiF: Mg, Ti) chips was 10.02 ±0.48mGy against the standard value (10mGy), the maximum deviation for the entire 10 chips was < ±10%. Similarly, 70% of the TL chips were below < ±5%. A study by Waqar et al[32] reported that the deviation between different shapes of TLD and ionisation chamber remained within 5% limit, using high energy photon. The margin of error in radiotherapy appears to be small compared to diagnostic radiology where an error margin may be tolerated.[33] The comparison of surface dose measurements of the TL chips against the reference chamber showed almost no discrepancy; the values of quotient of ESAK the MTS-N

Table 1. Homogeneity test among the 10 selected MTS-N (LiF: Mg, Ti) exposed to 10mGy

No	Mi	Mo	(Mi-Mo)	Δx	IEC
TL_1	1204183	128446	1075737	1.81	Accept
TL_2	1298960	44843	1254117	18.69	Accept
TL_3	1416232	104064	1312168	24.18	Accept
TL_4	1321158	264501	1056657	24.18	Accept
TL_5	1418463	238997	1179466	11.62	Accept
TL_6	1364586	147570	1217016	15.18	Accept
TL_7	1355975	227091	1128884	6.84	Accept
TL_8	1283832	158902	1124930	6.46	Accept
TL_9	1294777	143330	1151447	8.97	Accept
TL_{10}	1356332	150557	1205775	14.11	Accept

Table 2. The Element Correction Factor (ECF) for 10 selected TL signal exposed to 10mGy

No	TL Signal (count)	ECF (This study)	ECF range[30]	ECF range[31]
TL_1	1204183	1.1	0.8-1.2	0.7-1.5
TL_2	1298960	1.0	0.8-1.2	0.7-1.5
TL_3	1416232	0.9	0.8-1.2	0.7-1.5
TL_4	1321158	1.0	0.8-1.2	0.7-1.5
TL_5	1418463	0.9	0.8-1.2	0.7-1.5
TL_6	1364586	1.0	0.8-1.2	0.7-1.5
TL_7	1355975	1.0	0.8-1.2	0.7-1.5
TL_8	1283832	1.0	0.8-1.2	0.7-1.5
TL_9	1294777	1.0	0.8-1.2	0.7-1.5
TL_{10}	1356332	1.0	0.8-1.2	0.7-1.5

Table 3. ESAK comparison between Ionization chamber and MTS-N (LiF: Mg, Ti)

No	MTS-N (LiF: Mg, Ti) measurement	Ionization Camber measurement	% Deviation
TL_1	9.1	10	-9
TL_2	9.8	10	-2
TL_3	10.6	10	6
TL_4	9.9	10	-1
TL_5	10.7	10	7
TL_6	10.3	10	3
TL_7	10.2	10	2
TL_8	9.7	10	-3
TL_9	9.7	10	-3
TL_{10}	10.2	10	2

chips against the ionisation chamber was 1.002 with accuracy of ±0.2%, which was quite lower than Jankowski et al.[34]

LIMITATION OF THE STUDY

Only a single dose (10mGy) was considered for investigation.

RECOMMENDATION

A further study would be helpful at lower and higher doses. This will help expand the study. Also, patient dosimetry is still a challenge in the studied region. With this positive validation, the use of MTS-N chips should be encouraged as a tool for patient dosimetry/audit.

CONCLUSION

The MTS-N (LiF: Mg, Ti) chips to the DCT-10mm ionisation chamber with kilovoltage X-ray machine for patient dosimetry produced an accuracy 0.2% with 10mGy. The findings underscored the validity of the chips. This study was done to assist radiographic centres that cannot afford DAP meters, to perform patient dose assessment. Futures studies should focus on low (routine) and high (special procedure) radiographic examinations.

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FUNDING

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CONFLICT OF INTEREST

None.

CONTRIBUTIONS OF AUTHORS

AO (F.M.C Asaba) design of study, data collection and analysis, editing of manuscript; MA (CMUL Lagos) assisted in design of the study, data collection, write up and drafting and editing of manuscript; SA, and KO, analysis, and drafting of manuscript.

REFERENCES

1. Alashrah S, Kandaiya S, Maalej N, El-Taher A. Skin dose measurements using radiochromic films, TLDs and ionisation chamber and comparison with Monte Carlo simulation. Radiat Prot Dosimetry 2014; 162:338-44.
2. Stanton L, Day JL, Brattelli SD, Lightfoot DA, Vince MA, Stanton RE. Comparison of ion chamber and TLD dosimetry in mammography. Med Phys 1981; 8:792-8.
3. Yusof FH, Ung NM, Wong JHD, Jong WL, Ath V, Phua VCE, Heng SW, Ng KH. On the use of optically stimulated luminescent dosimeter for surface dose measurement during radiotherapy. PLoS ONE 2015; 10: e0128544.
4. Kry SF, Alvarez P, Cygler JE, DeWerd LA, Howell RM, Meeks S, O'Daniel J, Reft C, Sawakuchi G, Yukihara EG, Mihalidis D. AAPM TG 191: Clinical use of luminescent dosimeters: TLDs and OSLDs. Med. Phys 2020; 47: e19-e51.
5. Ponmalar R, Manickam R, Ganesh K M, Saminathan S, Raman A, Godson HF. Dosimetric characterisation of optically stimulated luminescence dosimeter with therapeutic photon beams for use in clinical radiotherapy measurements. J Can Res Ther 2017; 13:304-12.
6. Optically stimulated luminescent dosimetry for high dose rate brachytherapy Tien CJ, Ebeling RM, Hiatt JR, Curran B, Sternick E. Front Oncol 2012; 2: 91.
7. Park MY, Jung SE. Patient dose management: focus on practical actions. J Korean Med Sci 2016; 31 Suppl 1(Suppl 1): S45-S54.
8. Herrati A, Bourouina M, Khalal-Kouache K. Investigation of TLD-700 energy response to low energy x-ray encountered in diagnostic radiology. Open Phy 2016; 14:50-158.
9. Furetta C. Handbook of thermoluminescence. Singapore: World Scientific Publishing, 2003; pp1-39.
10. Podgorsak EB. Radiation oncology physics: a handbook for teachers and students. Vienna: IAEA Publications, 2005; pp71-348
11. Massillon-JL G, Johnston CSN Kohanoff J. On the role of magnesium in a LiF: Mg, Ti thermoluminescent dosimeter. Journal of Physics: Condensed Matter 2018; 31: 025502.
12. Gonzalez PR, Quiroz MC , Azorin J, Furetta C, Avila O. Improvement in the preparation method of LiF: Mg, Cu, P thermoluminescent phosphor. Journal of Applied Sciences.2005; 5: 1408-1411.
13. Rahimi M, Zahedifar M, Sadeghi E. Synthesis, optical properties and thermoluminescence dosimetry features of manganese doped Li2B4O7 nanoparticles. Radiat Prot Dosimetry 2018; 181:360-367.
14. Salah N, Sahare PD, Lochab SP, Kumar P. TL and PL studies on CaSO4: Dy nanoparticles Radiat Meas 2006; 41: 40-7
15. Erfurt G, Krbetschek MR. A radioluminescence study of spectral and dose characteristics of common luminophors. Radiat Prot Dosimetry 2002; 100:403-6.
16. Weinstein M, Shemesh Y, Abraham A, German U. Use of statistical checks as maintenance tools for TLD readers. Radiat Prot Dosimetry 2007; 125:109-12.
17. Nitrosi A, Bertolini M, Borasi G, Botti A, Barani A, Rivetti S,Pierotti L. Application of QC_DR software for acceptance testing and routine quality control of direct digital radiography systems: initial experiences using the Italian Association of Physicist in Medicine quality control protocol. J Digit Imaging 2009; 22: 656-666.
18. IBA dosimetry. MagicMax universal user's guide. IBA Dosimetry GmbH, Schwarzenbruck Germany: IBA Dosimetry GmbH, 2019.
19. Furetta C, Weng PS. Operational thermoluminescence dosimetry. Singapore: World Scientific Publishing, 1998; pp. 1-247
20. Rasuli B, Mahmoud-Pashazadeh A, Ghorbani M, Juybari RT, Naserpour M. Patient dose measurement in common medical X-ray examinations in Iran. J Appl Clin Med Phys 2016; 17: 374-386.
21. Health Canada. Safety code 35: safety procedures for the installation, use and control of X-ray equipment in large medical radiological facilities. Cat. No.: H128-1/08-545E. Ottawa (ON): Minister of Health; 2008.
22. Healing Arts Radiation Protection (HARP) Acts. Theory and practice: general radiography. Service Ontario. 2011
23. Papp J. Quality Management in the imaging science. 6th Ed. New York: Elsevier Publications, 2018
24. Sabar B Shah A Ahmad SA. Precision of low-dose response of LiF: Mg, Ti dosimeters exposed to 80 kVp X-rays. J Phys Sci 2011; 22: 125-130.
25. Moafi M, Geraily G, Shirazi AR, Teimouri J. Analysis of TLD-100 calibration and correction factor in different field sizes under low dose conditions irradiated with two systems: gamma knife 4C and theratron 780-C. Biomedical Technologies. 2015; 2: 227-236.
26. Rahman MO, Hoque A, Rahman S, Begum A. Responses of LiF thermoluminescence dosimeters to diagnostic 60Co teletherapy beams. Bangladesh J of Medical Physics 2015; 8: 14-21.
27. Luay AR Naashat RA Alaa FH. Linearity test for Harshaw TLD (Type: TLD-100H) based on individual calibration method. Nuclear Science 2019; 4: 1-5.
28. Cao Y. Physics characterisation of TLD-600 and TLD-700 and acceptance testing of new XRAD 160 biological X-ray Irradiator.

Published MSc thesis, Duke University, 2013.

29. Liuzzi R Savino F D'Avino V Pugliese M Cella L. Evaluation of LiF: Mg, Ti (TLD-100) for intraoperative electron radiation therapy quality assurance. PLoS ONE 2015; 10: e0139287.
30. Plato P, Miklos J. Production of element correction factors for thermoluminescent dosimeters. Health Phys 1985; 49(5): 873-881.
31. Kong TY, Kim HG. Application of element correction and personal dose equivalent response to extremity dosimeters used at Korean nuclear power plants. J of Nuclear Science and Technology 2012; 49; 352-359.
32. Waqar M, Ul-Haq A, Bilal S, Masood M. Comparison of dosimeter response of TLD-100 and ionisation chamber for high energy photon beams at KIRAN Karachi in Pakistan. The Egyptian J of Radiology and Nuclear Medicine 2017; 48(2): 479-83.
33. Soudjay S, Jeanne RM, Vololona RG, Roland R, Fanja RH, Naivo R, Harimalala RT. Efficiency of thermoluminescents dosimeters for patient dose assessment in medical radiology in Antananarivo. Radiation Science and Technology 2019; 5: 5-10.
34. Jankowski J, Domienik J, Papierz S, Padovani R, Vano E, Faulkner K . An international calibration of kerma–area product meters for patient dose optimisation study. Radiat Prot Dosimetry 2008; 129: 328-332.

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