

The measurement report of SDM

Investigation on Calibration Characteristics of Skin Dose Monitor (SDM) and Individual Difference

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Abstract— There is a need for an easy skin dose measurement. In order to avoid a deterministic effect of a patient and to reduce exposed dose on the patient in various X-ray examinations such as Interventional Radiography (IVR). We had a chance to use a Skin Dose Monitor (SDM) capable of measuring an accumulated skin dose at real time. Accordingly, we investigated, in particular, with regard to the calibration characteristics and the individual difference of sensors to accomplish reduction of factors of errors other than X-ray irradiation requirements.

Purpose of the study

We investigated, in particular, with regard to the calibration characteristics and the individual difference of sensors to accomplish reduction of factors of errors other than X-ray irradiation requirements.

Method

Model SDM 104-101 product of “McMahOne medical Co.Ltd”. And an ionization chamber dosimeter was used for simultaneous expose, so as to obtain the characteristic feature due to calibration and the characteristic due to the individual difference of optical fiber sensors, which are the problems as factors of errors other than irradiation conditions in an X-ray diagnostic region.

Content

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obtain the characteristic feature due to calibration and the characteristic due to the individual differences of optical fiber sensors, which are the problems as factors of errors other than irradiation conditions in an X-ray diagnostic region.

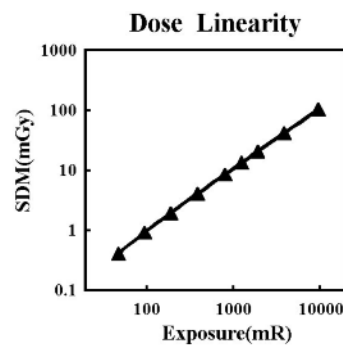


Figure 1 Relationship between Exposure and SDM.

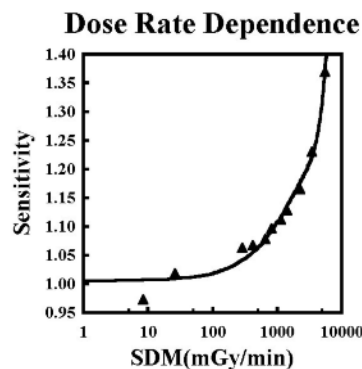


Figure 2 Relationship between SDM and Sensitivity.

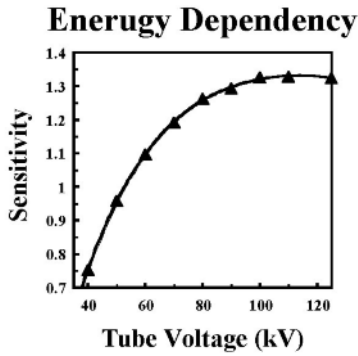


Figure 3 Relationship between Tube voltage and Sensitivity.

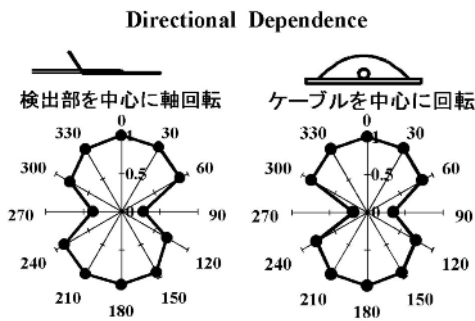


Figure 4 Directional Dependence.

The relationship between the sensitivity (y) of SDM and the calibration value (x) was shown as $y = 0.01234x - 0.03575$, wherein the relative coefficient $R^2 = 0.999$, which indicated linearity.

Calibration Characteristics of SDM

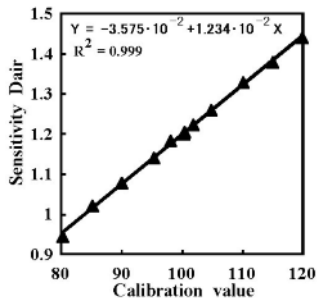


Figure 5 Relationship between Tube voltage and Sensitivity.

The calibration value became stable dozens of minutes after the power supply was on.

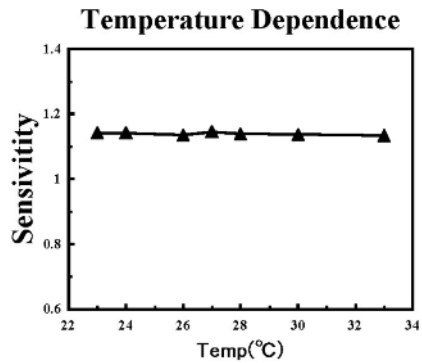


Figure 6 Temperature dependence

The average value of each sensibility of seven sensors was 1.3278, and the relative error was 7.8%. The X-ray irradiation on the main body of the SDM was a great factor of the measurement error.

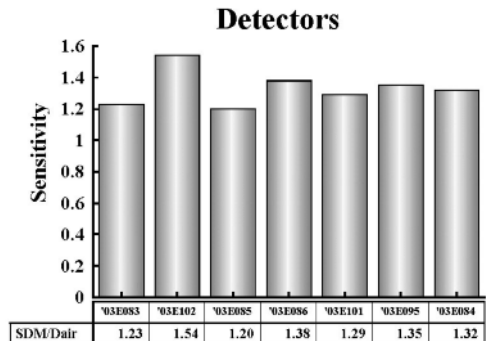
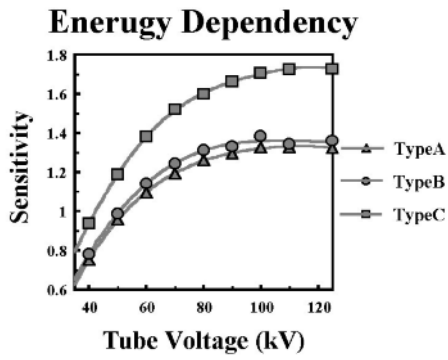


Figure 7 Sensibility of seven sensors

The fluctuation of the calibration value was directly reflected in the measurement error, since the calibration value is not stable until 40-50 minutes lapse after the power is on, it becomes the measurement error. Since the sensibility of each sensor is not standardized, it also becomes the measurement error.



The direct irradiation on the main body of the SDM is contraindication. Accordingly, it is possible to have a high-precision skin dose measurement using SDM with the following measures:

Figure 8 Energy dependency of sensor type

Relationship between temperature and calibration value

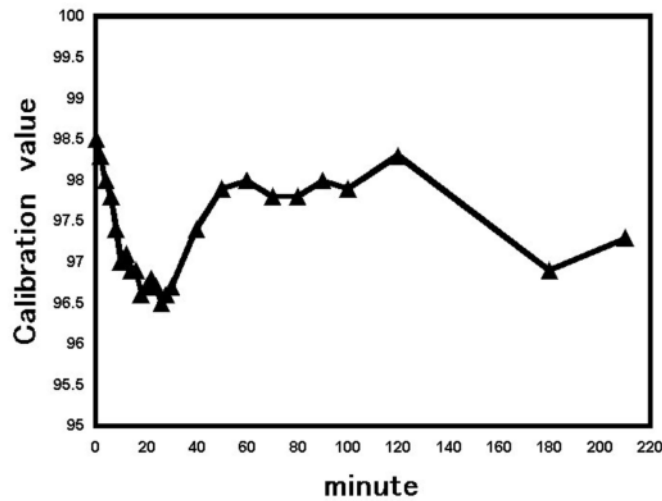


Figure 9 Relationship between temperature and calibration value.

Each part of measurement value (mGy)

80kV	13.1	0.0	10.5
100kV	26.8	0.0	16.7
125kV	49.4	0.0	24.7

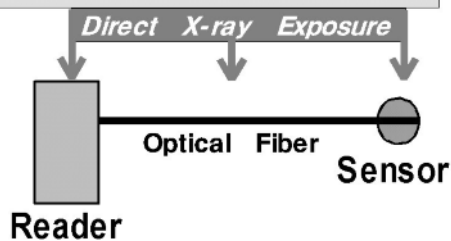


Figure 10 Each part of X-ray Exposure

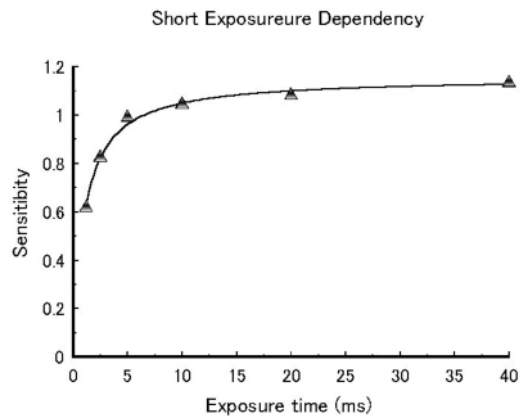


Figure 11 Short exposure dependency

Issues for Discussion

Accordingly, it is possible to have a high-precision skin dose measurement using SDM with the following measures. Putting the power supply on at last 45 minutes before using. Using for a long time, measuring calibration values before and after the examination. Each sensor to have a calibration constant. Taking covering of the main body.

Conclusion

- (1). Putting the power supply on at last 45 minutes before using the SDM
- (2). In a case of using the SDM for a long time, measuring calibration values before and after the examination
- (3). Conducting a reference irradiation for each sensor to have a calibration constant
- (4). Taking covering of the main body of the SDM in consideration.

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