Purpose: We have recently developed a dynamic tumor tracking irradiation system using Vero4DRT (MHI-TM2000). It is needed to create a 4D correlation model between a fiducial marker implanted near a tumor and an external surrogate as a function of time by continuously acquiring both fluoroscopy images and external surrogate signals. The purpose of this study was to propose a new dosimetry method using Gafchromic XR-SP2 films to measure surface dose by fluoroscopy imaging.

Methods: First, half-value layers (HVLs) were measured using aluminum (Al) thicknesses (15 mm) at 40125 kVp. Subsequently, several films were irradiated using various milliampere second values on a solid water phantom. The surface air kerma were also measured using the chamber to calculate the surface doses under the same condition. Then, the calibration curve of dose vs. pixel values was calculated. Finally, surface dose by fluoroscopy imaging was measured using several pieces of film taped on the chest phantom. Orthogonal X-ray fluoroscopy imaging was simultaneously performed until completion of data acquisition for creating a 4D correlation model. Those films were scanned after irradiation using a flat-bed scanner and converted to dose by calibration curve.

Results: The HVLs for tube voltage within 40125 kVp ranged from 2.35 to 5.98 mm Al. The calibration curve between surface dose and pixel values was reasonably smooth. The differences between the measured and the calibrated doses were less than 3%. The hot spots with the maximum dose of 37.12 mGy were observed around the area overlapped by both fluoroscopic fields.

Conclusions: We have proposed a new dosimetry method using Gafchromic XR-SP2 films to measure surface dose by fluoroscopy imaging. This phantom study has demonstrated that it may be feasible to assess surface dose to patients during dynamic tumor tracking irradiation in clinic with ease after further investigation.

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