Purpose:To study the process of generating dose calibration curve for a new radiochromic film model (GafChromic XR-QA2) using ion chamber and flat-bed document scanner. To investigate the effectiveness of both scanning modes (reflection and transmission) for film dosimetry. To investigate the impact of scanning spatial resolution on the uncertainty of dose calibration.

Methods:The reference dosimetry system included GafChromic XR-QA2 (ISP, Wayne, NJ) films designed for low dose measurement of low energy photon beam, a Farmer-type ion chamber calibrated for absolute dosimetry for photon energies of 100kVp and 120kVp, and an Epson Expression 10000 flat-bed document scanner (Epson, Nagano, Japan). A kilovoltage cone-beam CT system mounted on Elekta linac (Elekta, Crawley, UK) was used to irradiate the films. Film response (pixel value change in reflection scanning mode or optical density change in transmission mode) was correlated to air kerma using ion chamber measurements. Fifteen dose points ranging from 0 to 9cGy were used to generate calibration curves with optimal fitting function selection. Calculation of uncertainty included experimental and curve fitting uncertainties. Several different scanning spatial resolutions were tested to study its impact on the experimental uncertainty of dose calibration curve.

Results:Both scanning modes generated repeatable and smooth calibration curves with small curve fitting uncertainty (<2%). Transmission scanning mode provided comparable result with reflection mode despite a semi-opaque white polyester layer in this model of film. The experimental uncertainty was lower than 4% for doses above 1cGy with 50 dots-per-inch (DPI) scanning spatial resolution, but went up to about 7% for 300 DPI spatial resolution in both scanning modes.

Conclusions:Dose calibration curves for XR-QA2 film were successfully generated coupling with uncertainty analysis. Transmission scanning mode was capable of doing reference dosimetry with this model of film. Low DPI setting of the scanner reduced the experimental uncertainty with sacrifice of spatial resolution.