

Purpose: To characterize the beam spot size of Siemens linear accelerators and assess its long-term stability for megavoltage cone-beam CT (MV-CBCT) application.

Method and Materials: A laminated beam spot camera of length 20 cm was constructed for the measurement of the beam spot size. With the linac gantry at 180°, the camera was positioned on the compensator tray and a Kodak XV film placed on it. An exposure was delivered using photon (6, 10, 18 MV) beams and the FWHM of the resulting source intensity profile used as a measure of the beam spot size. Measurement of the beam spot size was performed in both the gun-target direction (in-plane) and the cross-plane direction for seven Siemens accelerators. To assess the long-term stability of the beam spot size, measurements taken 1 year apart were compared to each other.

Results: The measured beam spot diameters (FWHM) range from 1.6–2.8 mm. For all accelerators, the in-plane spot size was equal to or larger than the corresponding cross-plane spot size by up to 0.6 mm. Treatment units of the same design had spot sizes that were, in general, not identical but differed by up to 1 mm. Comparison of measurements on the Primus' and Mevatrons showed the introduction of the former (new generation accelerators) did not necessarily lead to a reduction in the spot size. Also, beam spot sizes measured 1 year apart were found to be similar.

Conclusions: The new accelerator models did not in general provide an improvement in the spot size compared to the old models. Assessment of the long-term stability of the beam spot showed the spot size remains fairly stable over time. However, the observed spot sizes are large in relation to focal spot size of diagnostic x-ray imaging devices, and this might compromise MV-CBCT image quality.