

Purpose: To explore the feasibility of measuring virtual source-to-skin distance and mean-square angular spread for broad electron beams with a 2D ion chamber array.

Method and Materials: The virtual SSD (S_{vir}) and mean-square angular spread (θ^2_{vir}) for 6, 9, 12, 16, and 20 MeV electron beams from a Clinac 21EX (Varian Medical Systems) Linac were measured using a 2D ion chamber array PTW seven29 (PTW Inc.). Cone size 20 by 20 was used throughout the measurement to ensure side-scatter equilibrium. The virtual SSD was measured using FWHM method (based on measurements of variation of field size with the nominal source-to-detector distance). The PTW seven29 was exposed perpendicularly to the beam axis at nominal SSD of 100, 105, 110, 115, 120, and 125 cm. Using MultiCheck software (PTW Inc.), the FWHM and the penumbra of each beam profiles were obtained. A back projection of FWHM with nominal SSD giving straight line, the virtual SSD was deduced from the slope and the intercept of this line. At the same time, back projection of penumbra with air gap giving a straight line, the mean-square angular spread was calculated from the slope of this line along with published parameter¹.

Results: The measured virtual SSD and mean-square angular spread for broad electron beams were listed below:

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|---------------------------------------|-------|-------|-------|-------|-------|
| Electron Energy (MeV): | 6 | 9 | 12 | 16 | 20 |
| S_{vir} (cm): | 94.6 | 94.0 | 95.3 | 96.1 | 96.8 |
| θ^2_{vir} (rad ²): | 0.070 | 0.061 | 0.055 | 0.044 | 0.032 |

Conclusion: Both the virtual SSD and mean-square angular spread for broad electron beams were measured with PTW seven29 2D-Array. It provided the necessary parameters to perform clinical broad beam electron dosimetry, especially in a filmless department.

Reference: 1. Jamshidi A, Kuchnir FT, Reft CS. Determination of the source position for the electron beams from a high-energy linear accelerator. Med Phys. 1986 Nov-Dec; 13(6):942-8