Purpose: The purpose of this work was to measure the x-ray beam width and geometric efficiency (GE) of a multi detector computed tomography scanner (MDCT) for different beam collimations using radiochromic films. In MDCT, the primary beam width extends the nominal beam collimation to irradiate the active detector elements uniformly (called 'over-beaming'□) which contributes to increased radiation dose to the patient compared to single detector CT. Therefore, the precise determination of the primary beam width and GE is of value for any CT dose calculation using Monte Carlo or analytical methods.

Methods: Single axial dose profiles free in air were measured for 6 different beam collimations nT for a Siemens SOMATOM Sensation 64 Scanner with Gafchromic XR-QA2 films. The films were calibrated relative to the measured charge of a PTW semiflex ionization chamber (type: 31010) for a single rotation in the CT scanner at the largest available beam collimation of 28.8 mm. The beam energy for all measurements in this work was set to 120 kVp. For every measured dose profile and beam collimation the GEin-air and the full-width-at-half-maximum value (FWHM) as a value for the x-ray beam width was determined. Over-beaming factors FWHM / nT were calculated accordingly.

Results: For MDCT beam collimations from 7.2 (12x0.6 mm) to 28.8 (24x1.2 mm) the geometric efficiency was between 58 and 85 %. The over-beaming factor ranged from 1.43 to 1.11. For beam collimations of 1x5 mm and 1x10 mm the GE was 77 % and 84 % respectively. The over-beaming factors were close to 1, as expected.

Conclusions: This work has shown that radiochromic films can be used for accurate x-ray beam width and geometric efficiency measurements due to their high spatial resolution. The measured free-in-air geometric efficiency and the over-beaming factor depend strongly on beam collimation.