

An optimization method to derive extra-focal source from collimator scattering factor (S_c)

A focal-spot source plus an extra-focal source model is useful to determine the dependence of head scatter and beam penumbra on field size. Determination of the extra-focal source needs extra equipment and measurement, which are generally not available in a clinical environment. An optimization procedure is developed to derive the extra-focal source from routinely measured collimator scattering factor, S_c . S_c factors of square field are first obtained either from chamber measurements or from commission data. Differences of S_c between consecutive field sizes are used as the initial guesses of the extra-focal source. Focal-spot source strength is the extrapolated S_c value for field size 0. Calculated S_c factors from the current focal source and extra-focal source are compared with the measured S_c , and the differences are used to iteratively update the extra-focal source distribution until the difference is smaller than a preset tolerance. The S_c data from a Varian 2100C were used to test this approach. The optimized extra-focal source and focal-spot source were used to predict the S_c for sixteen rectangular fields. The results show that the calculated S_c from the optimized extra-focal source match the measured S_c to better than 0.02%, on average. The calculated S_c for 16 rectangular fields agree with the measured ones within 0.3%, on average. These results indicate that the extra-focal source can be determined from routinely measured S_c factors using the developed optimization procedure without extra equipment and measurement.