Effects of beam divergence, fluence distribution, and beam quality on the phantom-scatter factor

ABSTRACT

The phantom-scatter factor (S_p) takes into account of the change in scatter radiation originating in the phantom at a reference depth for a fixed collimator opening as the irradiated volume of phantom is changed. By this definition, the S_p factor can be affected not only by the volume of phantom irradiated, but also the characteristics of the primary beam, including the beam divergence, the fluence distribution, and the beam quality as a function of field size or distance from the central axis. The present research is to study the effects of the above factors on the phantom-scatter factor using the EGS4 Monte Carlo method. This method has a unique feature that allows us to differentiate the contributions from various factors and to exclude the head scatter and electron contamination. Quantifying the effects of the beam divergence, the fluence distribution, and the energy spectrum on the phantom-scatter factor is important, especially on how approximation can be made in primary beam modeling. For example, parallel beam instead of divergent beam is assumed in dose-calculation in both ADAC and Helax-TMS systems. Our preliminary study has shown that beam divergence contributes most to the improvement of accuracy of S_p calculation. The energy spectra are less important in this regard. The primary fluence distribution has negligible effect on the S_p calculation, as far as the lateral variation is within 4% of fluence value at the central axis.