AbstractID: 6889 Title: Calculating electron-beam central-axis depth doses using the Final Aperture Superposition Technique (FAST)

Purpose: To quickly calculate central-axis depth doses for arbitrarily-shaped electron inserts using precalculated differential dose data.

Method and Materials: Monte Carlo simulation (EGS4) is used to obtain phase space distributions in a plane upstream from the insert. From these distributions, central-axis dose in a water phantom is calculated for a) an open configuration with no insert in the applicator and b) a fully shielded configuration with a completely solid insert. Differential dose datasets are created by tagging the location of particles as they pass through the insert and scoring contributions to the dose from different regions. For arbitrarily-shaped inserts, the Final Aperture Superposition Technique (FAST) code adds open and shielded contributions given an outline of the insert opening. Differential dose datasets are calculated for a range of energies (6-21 MeV), applicator sizes (10-25 cm), and source-to-surface distances (100-110 cm). FAST calculations are compared with full Monte Carlo simulation through the insert using the same initial phase space distributions.

Results: FAST depth doses are similar to the full simulation but tend to be slightly lower in dose, particularly for higher energy beams. This “collimator effect” is due to the inability of FAST to score dose from particles that escape the shield through the edges of the insert opening. An average collimator effect curve has been defined using a linear fit to the average difference between full simulation and FAST for a 2 cm diameter opening and a fully open applicator. Using this curve to correct the FAST doses results in mean residual errors and standard deviations in these errors of less than a percent.

Conclusion: With a minor correction for the collimator effect, the FAST program can accurately calculate central-axis doses for a large range of treatment parameters.