AbstractID: 9029 Title: Use of Pencil-Beam Redefinition Algorithm for Electron Arc Dose Calculations

3D dose algorithms suitable for electron arc therapy treatment planning are presently not available in commercial treatment planning systems. Summation of multiple 3D fixed-beam dose distributions offers a feasible solution, and the pencil-beam redefinition algorithm (PBRA) should be suitably accurate. This work evaluates the accuracy of PBRA dose calculations in water for fixed beams that have air gaps and field shapes typical for electron arc therapy. Calculated and measured dose distributions are compared for combinations of two beam energies (10 and 15 MeV), three field sizes (4x20, 5x20, and 6x20 cm^2), and two SSDs (80 and 88 cm). For central-axis depth dose, the PBRA agrees within 2% in low-dose gradient regions ($d<R_{80}$ and $d>R_p$) and within 1-mm distance-to-agreement (DTA) in the high-dose gradient region ($R_{80}<d<R_p$) for all cases. In off-axis dose (D) comparisons, the PBRA agrees within 3% in the low-dose gradient regions ($D>80\%$ and $D<10\%$) for all combinations. The maximum discrepancy for off-axis dose in the high-dose gradient region ($10\%<D<80\%$) was 1-mm DTA for 10 MeV and 2 mm for 15 MeV. The accuracy of PBRA dose calculations meets Van Dyk's criteria of acceptability for fixed electron beams. The agreement supports using the PBRA in the proposed summation approach for arc dose calculations. Future work will include demonstrating the accuracy of summed PBRA dose distributions for the arced beam and in the presence of skin collimation.

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