Background

The electron Monte Carlo (eMC) algorithm in Eclipse treatment planning system have shown discrepancies between calculations and measurements, especially for lower energies, small applicator sizes, and large source-to-surface distances. These mismatches are known to be minimized with insertions of optional air profiles (APs), thus we evaluated the performance in terms of profiles, percentage depth dose and penumbra width.

Materials and methods

Electron beams with energies of 6, 9, 12, and 16 MeV for VitalBeam (Varian Medical System, Palo Alto, CA) and 6, 9, 12, 16, and 20 MeV for Clinac iX (Varian Medical System, Palo Alto, CA) were used. Optional APs were measured at a source-to-detector distance of 95 cm with jaw openings appropriate for each machine, electron beam energy, and applicator size. The electron beams were then modeled and calculated with and without optional APs. Measured profiles, percentage depth doses, and penumbra widths with respect to each machine and energy were compared to calculated dose distributions.

Results

For VitalBeam, the profile differences between the measurement and calculation were reduced by 0.35%, 0.15%, 0.14%, and 0.38% at 6, 9, 12, and 16 MeV, respectively, as the beams were modeled with APs. For Clinac iX, the differences were decreased by 0.16%, -0.31%, 0.94%, 0.42%, and 0.74%, at 6, 9, 12, 16, and 20 MeV, respectively, with insertions of APs. Notably, no significant improvements in penumbra width and percentage depth dose were observed, although the beam models were configured with APs.

Conclusion

The accuracy of the eMC calculation can generally be improved in profiles when electron beams are modeled with insertions of optional APs regardless of machine, energy, and applicator size.

References

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