Purpose: To evaluate the accuracy of electron dose calculated using the pencil-beam redefinition algorithm (PBRA) in patient-like 2D phantoms. With the recent availability of bolus electron conformal therapy (ECT), conforming of the 90% dose surface to the planning target volume (PTV) might require a more accurate dose calculation than the Hogstrom pencil beam algorithm (PBA).

Methods: PBRA-calculated dose distributions have been compared to those previously measured in three cylindrical phantoms (retromolar trigone, maxillary sinus, and nose), whose axial cross sections were based on the mid-PTV CT anatomy for each site. The phantoms consisted of SR4 muscle substitute, SR4 bone substitute, and air. TLD measured doses were reported for a matrix of locations in the SR4 muscle only. Current CT scan data was used for planning with CT to stopping and scattering power tables created based on the chemical compositions and current densities of the materials. Differences between PBRA-calculated and measured dose were expressed as distance-to-dose agreement in regions of high dose gradient (90%-10%) and as a percent of given dose elsewhere.

Results: Results from the PBRA for the retromolar trigone phantom showed 100% (27/27) TLD dose points within 5% and 95% (19/20) within 4mm. Similar results for the maxillary sinus phantom showed 79% (26/33) and 100% (19/19), respectively, and results for the nose showed 96%(23/24) and 100% (38/38), respectively. For each phantom, results were better than previously reported PBA results, e.g. results for the nose showed 81% (26/32) and 60% (18/30), respectively. Dose calculation times for the three sites (single 2.93GHz) were 1min, 45sec, and 1min.

Conclusions: Results of this study were consistent with those previously reported, namely that the PBRA is more accurate than the PBA and that it should be suitable for clinical situations where dose accuracy is more important, e.g. bolus ECT.

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