AbstractID: 4542 Title: Improving Homogeneity of Abutment Dosimetry in Segmented-Field Electron Conformal Therapy using Variable Insert Positioning

Purpose: To improve dose homogeneity in segmented-field electron conformal therapy by matching penumbra of abutted fields.

Method and Materials: A Varian 21EX electron applicator was modified to allow for energy-dependent positioning of Cerrobend inserts resulting in energy-dependent air gaps. Air gaps were chosen based on theoretical calculations to approximately match penumbra for 6, 9, 12, 16, and 20 MeV beams at 1.5-cm depth in a water phantom at 100-cm SSD. Treatment plans developed for four simulated target volumes using the modified applicator were compared to identical plans using the standard applicator. Improvement in dose homogeneity was assessed by comparing maximum and minimum dose, mean dose, and sigma of the dose distribution in the target volume for the two plans. Subsequently, electron blocks were cut with diverging edges using the Compu•cutter® system, and dose plans using the modified applicator were delivered to Kodak XV film in a polystyrene phantom to demonstrate feasibility.

Results: Treatment planning results using the modified applicator showed improved dose homogeneity in all four simulated target volumes as compared to plans using the standard applicator. Averaged for all four PTVs; dose spread (D_{max} - D_{min}) decreased by 35%, σ of the dose distribution decreased by 29%, and $D_{90\text{-}10}$ decreased by 31%. Dose delivered to a film phantom using the modified applicator was found to agree well with predictions (within approximately 5%) of the Pinnacle treatment planning system in the abutment region of the PTV (±2 cm from the abutment edge at depths ≥ 1.5 cm).

Conclusion: The results of this study suggest segmented-field electron conformal therapy can be delivered with significant improvement in dose homogeneity as compared to the current method by using energy-dependent positioning of electron inserts to match beam penumbra.