AbstractID: 6787 Title: Improvement of the Convolution/Superposition algorithm for IMRT dose calculations

Purpose: To study improvements to the Convolution/Superposition (CS) dose calculation algorithm which enhance IMRT dose calculation accuracy.

Method and Materials: Several aspects of typical CS calculation algorithms can be improved in order to increase the accuracy of IMRT dose calculations. To improve beam modeling and fitting, CS polyenergetic kernels were based on newly generated individual energy deposition kernels which are calculated on a high resolution grid using the Monte Carlo simulation package PENELOPE and relative contributions obtained from a detailed simulation of the accelerator head using the Monte Carlo code BEAM. Further improvement resulted from beam fitting based on data carefully measured using different detectors to better model dose in different regions of the dose distribution (e.g. beam penumbra, leaf and jaw transmission, buildup region, etc). Additional features added to enhance the CS algorithm included calculation of collimator scatter (for shaped and IMRT fields), an electron contamination correction for the buildup region for both the individual beamlet and final dose calculations, and modeling of the complete SMLC delivery sequence, allowing a more realistic final dose calculation after the optimization process is completed.

Results: Comparison of output**,** depth dose and various dose profiles for square and shaped fields demonstrate the improved results for basic beam modeling. Ion chamber and 2-D dose distributions measured for a series of IMRT fields illustrate the increased accuracy possible with the enhanced algorithm. Routine IMRT QA accuracy showed an average improvement of 3% with respect to the more standard CS implementation.

Conclusion: Enhancements to standard convolution/superposition algorithm implementations can significantly improve accuracy for shaped field and IMRT dose calculations throughout the patient, including the buildup region, penumbra and outside the field.