

AbstractID: 4921 Title: What is the optimal source-to-collimator distance for an extendible MLC designed for energy- and intensity-modulated electron radiation therapy of superficial tumors

Purpose: To determine an optimal source-to-collimator distance (SCD) for an extendible multi-leaf collimator (exMLC) designed for energy- and intensity-modulated electron radiotherapy for superficial tumors.

Method and Materials: To implement an extendible Modulated Electron Radiation Therapy (exMERT) technique for optimized radiotherapy of superficial tumors, we designed a virtual exMLC and investigated the effect of SCD on the characteristics of resulting electron beams. An exMLC made of tungsten leaves of 15 mm thickness and 5 mm width and with straight leaf ends was modeled as a MLC component module in EGS4/BEAM simulations. Phase space files were scored at the back surface of the exMLC and at 100 cm SSD for 6 to 20 MeV electron beams emerging from a Varian Clinac 21EX treatment head equipped with exMLC located at SCDs of 85, 90 and 95 cm. These phase space files were then analyzed using BEAMDP and used as beam input for further dose calculations in water.

Results: At shorter SCD (85 cm), the in-air scatter and dose overlapping at depth were the worst compared to other SCDs. The 80-20 penumbra of 1 cm × 1 cm beamlet was 0.92 cm at 100 cm SSD and 1.35 cm at 2 cm depth in water for 6 MeV beam. On the other hand, the leaf scatter and leakage from the exMLC located at 95 cm SCD resulted in larger bremsstrahlung photon dose (~4% of maximum dose for 20 MeV electrons). Overall, the exMLC at 90 cm SCD yielded modest leaf scatter and leakage as well as dose overlapping at depths, acceptable to clinical applications of exMERT with good clearance for patient setups.

Conclusions: Based on the consideration of beam penumbra, photon contamination, and patient clearance, the SCD of 90 cm was determined to be the best compromise for exMLC to be used in exMERT.