AbstractID: 6553 Title: Development of an electron multileaf collimator performing computer-controlled beam collimation and isocentric dose delivery with electrons

Purpose: To develop an add-on multileaf collimator for electrons (eMLC) and to verify its efficiency according to the design goals.

Method and Materials: The design parameters were determined such that a compact and light-weight eMLC can be manufactured and stable mounted on a conventional accelerator. The source-to-collimator distance (SCD) was optimized to avoid patient realignments during gantry rotation and with consideration of the required maximum field size and minimum beam penumbra. To verify the efficiency of the eMLC, the stability of the mounting was examined at all gantry angles. Additionally, at 6-14 MeV and field sizes of 3x3-20x20 cm, the dose distribution and the optimal jaw setting were determined with a pinpoint ionization chamber. The radiation leakage was measured with radiochromic films.

Results: A prototype was constructed consisting of 2x24 motorized brass leaves with 1.8 cm height. Since the necessary distance between eMLC and patient surface can significantly vary, the eMLC can be placed at 84 and 72 cm SCD implemented by interchangeable distance holders. At these SCDs, the maximum field sizes are 17x17 and 20x20 cm, respectively. The prototype weights 23 kg and thus causes no gantry sag. Additionally, the sag of the distance holder is less than 0.5 mm at all gantry angles. Compared to the dose distributions of the applicator at 6-14 MeV, the penumbra of the eMLC at 84 and 72 cm SCD are 0.8-0.6 and 1.8-1.0 cm greater respectively and the depth-dose curves show a larger build-up effect. Due to the tongue-and-groove leaf shape, interleaf leakage is negligible. The leaf-end leakage could be eliminated by adjoining the leaf-ends off-axis. At 14 MeV, bremsstrahlung results in 2 % intraleaf leakage.

Conclusion: The eMLC facilitates computer-controlled beam collimation and isocentric dose delivery at all gantry angles necessary to expand the IMRT techniques to electrons.