Purpose: The primary benefit of removing the flattening filter of a linear accelerator is to increase the dose rate by a factor of 3 to 6. Additionally, change in scatter conditions in the head of the accelerator may also decrease the penumbra, which could lead to better target conformality. The purpose of this work is to evaluate this effect on a Siemens Artiste linear accelerator.

Methods: Profiles of 10 ×10 cm2 flat and flattening-filter-free (FFF) fields were measured in water using a scanning diode with 0.3 mm steps. The penumbra created by both the 160-leaf multileaf collimator (MLC) and the backup jaw (Y-jaw) was measured. The profile of the FFF beam was renormalized so that for both flat and FFF beams, the penumbra was defined as the distance between the points with 20% and 80% of the central flat beam dose. The penumbra was measured every 5 cm along the major axes and around the central axis at four depths from 1.5 to 20 cm.

Results: The average penumbra defined by the MLC and Y-jaw was 4.9 mm and 5.9 mm, respectively for the flat beam, and 4.9 mm and 5.2 mm for the FFF beam. The flat beam penumbra increased with depth from 4.6 to 9.2 mm and 5.5 to 10.1 mm for the MLC and Y-jaw respectively. The corresponding increase for the FFF beam penumbra was 4.6 to 9.2 mm and 4.6 to 8.8 mm. The average paired difference was <0.1 mm for the MLC and 0.8 mm for the Y-jaw.

Conclusion: The MLC penumbra was not affected by removing the flattening filter, while the decreased scattering in the FFF beam reduced the Y-jaw penumbra by 0.8 mm. Removing the flattening filter does not clinically significantly improve the way the MLC can conform to the target.

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