

Simplified sigmoidal curve fitting for 6 MV FFF photon beam of Halcyon to determine field size for Beam commissioning and quality assurance

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Purpose: Delivery of a single energy 6 MV flattening filter free (FFF) photon beam is a main characteristic of an O-ring gantry type linear accelerator (linac) Halcyon. The purpose of this study is to determine the field size of the beam through an application of the simplified sigmoidal curve fitting (SCF) to the beam profiles obtained from the preconfigured reference data of Halcyon, and then to compare its parametrization with the measured beam data from Halcyon.

Methods: After a mathematical definition of the SCF using four coefficients, the defined curves were fitted to both the reference and measured data. When a high agreement between the fitting curve and the profiles in each data, the field sizes were determined by identifying the maximum point along the third derivative of the fitting curve. The curve fitting included the field sizes for beam profiles as 2×2 , 4×4 , 6×6 , 8×8 , 10×10 , 20×20 and 28×28 cm² as a function of depths (at 1.3, 5, 10, 20 cm). The results of the field size from the reference data were compared with the results in the measured data using same condition.

Results: All fitting curves show an average agreement ratio higher than 97% and the values of goodness of fit, R^2 , as better than 0.99. The differences of the field size between the reference data and the measured data were within the range of 0 to 0.2 cm. The least difference of the field sizes at depth 10 cm which is a surface to axis distance was reported.

Conclusion: The application of the SCF has been proved to accurately obtain the field size of the preconfigured reference and of measured FFF photon beam data for Halcyon. The current work can be useful to the beam commissioning as a countercheck methodology to the field size from the reference data in the treatment planning system of a newly installed Halcyon and to the routine quality assurance to ascertain the correctness of field sizes clinically used with the Halcyon.

Key Words: Field Size, Sigmoidal Curve Fitting, FFF, Halcyon, Commissioning, QA