

AbstractID: 10802 Title: Gamma is a necessary, but not sufficient criteria for comparing dose distributions

Purpose: To demonstrate via simple test cases that although percent pass gamma ($\gamma < 1$) may be a necessary condition for acceptance in dosimetric analysis, it is not a sufficient condition to ensure dose integrity and therefore should not be used as a sole of criterion to judge dosimetric acceptability.

Method and Materials: Simple modifications to the delivery of treatment fields are created such that, although $> 98\%$ of points have $\gamma < 1$ with respect to the reference field when 2D planar fluence/dose verification images are acquired, the resultant dose distributions are clinically unacceptable. Gamma criterion of 3%, 3 mm and 5%, 5mm are used. Reference test fields include a $10 \times 10 \text{ cm}^2$ open field with 5mm gap sweeping and two modified $10 \times 10 \text{ cm}^2$ fields. Deviations include shrinking the dose distribution by 3 mm, and introducing a non-moving 5 mm wide MLC leaf in the interior of a field.

Results:

The two-dimensional field that is narrower than the reference field can have 100% of the points with $\gamma < 1$. A non-moving 5 mm MLC leaf in a $10 \times 10 \text{ cm}^2$ sliding window can have 94.5% of the points passed 3%, 3mm gamma test and 97.8% of the points passed 5%, 5mm gamma test. Similarly, fields with dose peaks or valleys in them with dimensions up to two-times the DTA criteria can have 100% of points with $\gamma < 1$. Exchanging to roles of the reference and test images in the gamma evaluation can be distinguish some, but not all, of the clinically relevant errors.

Conclusion: Evaluation of the fraction of points with $\gamma < 1$ may be a necessary condition, but it is not sufficient to state a plan is dosimetrically acceptable. Evaluation of additional dose metrics is required to show clinical acceptability.

Conflict of Interest: Research supported in part by Varian Medical Systems and NIH P01 CA116602.