Each intensity-modulated radiation therapy (IMRT) field includes many small, irregular, and asymmetric fields that completely obscure the relationship between monitor unit (MU) setting and radiation dose. Uncertainty and inaccuracy of dose delivery with IMRT is primarily attributed to the leaf positioning accuracy, modeling of radiation output for small field sizes, modeling of beam penumbra, and the dose outside the IMRT field. Dose-difference distribution, distance-to-agreement (DTA), and a numerical gamma index are often used to evaluate the quality of agreement between measured and calculated dose distributions for the IMRT fields. The tolerance limits based on these indices for IMRT QA are often not adequate because all these methodologies do not account for space-specific dose uncertainty information. In other words, single tolerance criterion is applied to all test points even when dose uncertainty is significantly different from point to point. At any given point, the dose uncertainty depends on different levels of dose and gradients from multiple small beams rather than that of the overall dose profile. Therefore, new methodologies are needed that determine dose uncertainties based on the dose level and gradient information of each small field.

In IMRT, it is sometimes difficult to have agreement between calculation and measurement of dose at all points in a 3-D dose distribution. A disagreement at a few points does not necessarily lead to negative overall result if other comparable points are well within the established tolerance limits. We will describe a new approach in establishing tolerance limits and action levels for IMRT QA that will ensure delivery of prescribed radiation dose within an acceptable limit of 5%.

Educational Objectives:

1. To describe the uncertainties in IMRT planning and delivery
2. To describe the impact of spatial and dosimetric uncertainties on the IMRT dose distribution
3. To describe the limitations of current methodologies of establishing tolerance limits for IMRT QA
4. To describe new methodologies for establishing tolerance limits for IMRT QA

AbstractID: 7910 Title: Frequencies, tolerance limits, and action levels for IMRT QA