Purpose: As clinics begin to use 3D quality assurance (QA) metrics, an investigation into appropriate action limits is required. This can be accomplished by comparing results of the 3D metric to the existing 2D metric. To investigate this, we compared 2D and 3D gamma analysis results to determine 3D gamma action limits that would result in comparable 2D QA outcomes.

Methods: 2D and 3D gamma QA analysis results for ten clinical IMRT patients using a variety of distance-to-agreements (DTA), dose-thresholds, and interpolated slice thicknesses were chosen for this study. Clinical treatment planning system (TPS)-calculated dose (evaluated) distribution and Monte Carlo-calculated (reference) dose distribution were compared using DoseLab (Mobius Medical Systems) gamma analysis software that calculates 2- and 3-dimensional gamma index for a given DTA. Each comparison evaluated the 2- and 3-D average gamma and percent of pixels passing for the following acceptance criteria: ±5%/5mm, 3%/3mm, 2%/2mm, and 1%/1mm using 1 mm slice thicknesses (no dose threshold used). The effect of low-dose thresholds and slice thickness was also evaluated.

Results: The percent of pixels passing for each DTA was better for 3D as compared to the 2D analysis (2D vs 3D): 99.8% vs. 99.9% for 5%/5mm, 99.0% vs. 99.7% for 3%/3mm, 96.4% vs. 98.4% for 2%/2mm, and 79.3% vs. 83.4% for 1%/1mm. Using the low-dose threshold resulted in worse gamma for both 2D and 3D gamma. However, similar to the no-threshold results, use of dose threshold resulted in worse agreement for 2D than 3D for all DTA (4.1% decrease compared to 1.7% at 15% low-dose threshold). No appreciable differences in gamma were observed as a function of slice thickness.

Conclusions: Clinical use of 3D gamma analysis requires use of action limits (% of pixel passing and γ values) that are more stringent than 2D for comparable QA results.