AbstractID: 14194 Title: An integration calculation method for dose verification of arc-based radiotherapy

Purpose: Arc techniques can improve dose delivery efficiency and isodose distributions but can also introduce uncertainties in dose calculation particularly for tissue heterogeneity and irregular external contours within an arc. Available QA programs have failed to produce accurate MU calculation. Thus, we introduce a new QA algorithm for arc radiotherapy.

Method and Materials: Modified power law (MPL) and equivalent path-length (EPL) with/without modified Clarkson integration (MCI) were used for MU verification in arc therapy for 21 patients with small lung tumors or brain lesions. Instead of treating each arc as multiple beams with 5-degree gantry angle interval, we averaged the CT density over the arc with a given radius and then integrated over the radii to determine the effective density and the true heterogeneity-corrected path-length (TPL). Planned CT and arc data in DICOMRT format were parsed into a custom program and geometry between the dose point and a moving ray with fixed angle relative to the dose point in the beam-eye-view (BEV) were converted to a fixed beamlet relative to the point having its own effective density distribution along the path-length. Then, concepts of MCI were used.

Results: In cases with arc MU deviation of 5 to 18% using existing algorithms, application of the proposed algorithm of the true arc integration had significantly reduced the dose deviation to < 6% because the TPL corrected the EPL by up to 17 mm. The equivalent square of the field improved correction by another 2 to 5%.

Conclusion: A novel arc integration algorithm has been tested successfully for quantification of effects of tissue heterogeneity, irregular surface, and position devices in arcs. The arc-integration and the concepts for converting arcs to fix beams provide a new dose calculation and QA tool for emerging arc techniques.

Conflict of Interest (only if applicable):