Purpose: To investigate the dosimetric effect of intrafraction tumor motion during gated RapidArc Stereotactic Body Radiotherapy (SBRT) delivery.

Method: The realtime tumor motion data were retrieved from 6 lung patients. Each of them received 3 fractions of stereotactic radiotherapy treatments with Cyberknife Synchrony. Phase gating through an external surrogate was simulated with a gating window of 5 mm. The resulting residual tumor motion curves during gating (beam-on) were retrieved. RapidArc SBRT was planned on the platform of Varian Truebeam at 6 MV with 1400 MU/min. Planning target volume (PTV) was defined as physician-contoured clinical target volume (CTV) surrounded by an isotropic 5 mm margin. Each patient was prescribed with 60Gy/3 fractions. The RA plan typically consists of 2 arcs; each contains 90-120 control points. An algorithm was developed to reconstruct the delivered dose with tumor motion. The MLC segment is assumed to move relatively to a static tumor. Each MLC control point, mainly the leaf position were modified according to the probability density function of tumor motion. The newly created MLC control points were written back to the treatment file in the dicom format which was subsequently imported to treatment planning system (Varian Eclipse) for dose recalculation.

Results: The magnitude of dose deviation with motion is consistent with the excursion of the residual tumor movement. Overall CTV coverage of the study group is barely affected owing to the 5 mm margin. The fractional PTV dose coverage dropped by 4% at most and that from all fractions by 3%. An examination in the point dose shows an increase of 4% in the maximum dose and decrease of 10% for the minimum dose.

Conclusion: With effective gating, interplay effect does not change the target coverage much during gated RapidArc SBRT. However it increases the dose nonuniformity inside target.