

**Purpose:** To quantify the interplay effect for various IMRT techniques used to deliver Stereotactic-Body Radiation Therapy (SBRT) to early-stage lung cancer.

**Methods:** Five lung cancer patients who received SBRT were retrospectively planned (54Gy/3fx) on the average 4D-CT dataset with eight different IMRT techniques: three fixed-beam IMRT plans (simple step-and-shoot (S/S), complex S/S, and sliding-window (S/W)), Tomotherapy plans using three different beam sizes (1cm, 2.5cm, and 5cm), and two Volumetric-Modulated Arc Therapy (VMAT) plans (one planned with Rapid Arc (Eclipse v8.9, Varian Medical Systems, Palo Alto, USA) and one planned with Smart Arc (Pinnacle v9.0, Philips Medical Systems, Cleveland, USA)). All treatment plans were calculated on a CT of the ArcCHECK phantom by Sun Nuclear (Gland, Switzerland) that was mounted on the QUASAR™ Programmable Respiratory Motion Platform (Modus Medical Devices Inc., London, Ontario). Each plan was delivered under the following motion conditions: 1) Static mode; 2) Sinusoidal mode (4s period) with S/I motion ranging from 5mm-20mm peak-to-peak in 5 mm increments; 3) Real-patient waveforms ranging from 5mm-30mm peak-to-peak. A standard 3%/3mm gamma analysis compared each delivery to their corresponding calculated plan.

**Results:** All methods were acceptable on average (>90% points pass) up to 15mm peak-to-peak motion except for the Rapid Arc plan, which had a significantly less pass rate (75.6+/-3.9%) than all other techniques ( $p < .02$ ). Tomotherapy plans using either a 2.5cm beam (98.7+/-2.1%) or 5cm beam (96.8+/-3.5%) were still acceptable for motion up to 20 mm peak-to-peak. For irregular motion greater than 15mm, only the VMAT techniques failed ((74.9+/-16.6)% for Rapid Arc and (89.3+/-8.9)% for Smart Arc on average.

**Conclusions:** Interplay effect in SBRT delivery was dependent on the IMRT technique for peak-to-peak motions greater than 15mm. Tomotherapy was the least sensitive for motion up to 20mm. Rapid Arc was the most sensitive for motion greater than 15mm peak-to-peak.