Purpose: Despite of superior target dose uniformity, previous studies of helical tomotherapy (HT) show inferior longitudinal conformity and longer deliver time compared to volumetric-modulated arc therapy (VMAT) plans, due to fixed jaw size with conventional HT. Dynamic delivery techniques were introduced to overcome these problems. This study is to compare the dosimetric performance of dynamic tomotherapy delivery (5.0cm jaw running-start-stop (RSS)) with fixed jaw HT and VMAT deliveries.

Methods: Sixteen patient cases, including brain, head&neck (HN), lung and prostate, were selected and de-identified prior to treatment planning. VMAT plans were generated using Varian RapidArc™ (RA) (one or two arcs) and HT plans using TomoTherapy® (fixed 2.5cm jaw). The tomotherapy RSS plans were generated using tomotherapy's research engine and optimized based on 5.0cm dynamic jaw, which allows larger jaw opening for lower dose gradient and smaller jaw opening at the target border when sharp penumbra is required. All 16 cases were planned based on identical contours, prescriptions, and planning objectives. Dose indices for targets and critical organs were compared based on dose-volume histograms, delivery time, and monitor units.

Results: The average delivery time was reduced from 4.8min (HT) to 2.92min (RSS). RSS showed comparable target dose homogeneity to HT. Three delivery techniques showed comparable normal tissue sparing for lung cases, with improved sparing of cord with RSS. For prostate cases, RSS showed improved bladder and rectum doses compared to HT due to better longitudinal sparing. Superior normal tissue sparing was observed in RSS plans for optical nerves in brain cases and larynx or parotids for HN cases.

Conclusions: Tomotherapy RSS with 5.0cm dynamic jaw is overall comparable, if not better, to 2.5cm fixed jaw HT, with faster treatment delivery. It also showed improved longitudinal dose conformity to critical structures adjacent to the target, which is comparable to RA technique.

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Yu Chen is employee of Accuray-Tomotherapy, Inc.