AbstractID: 7244 Title: Impact of intra-fractional tumor motion for hypo-fractionated lung radiosurgery using Hi-Art TomoTherapy System

Purpose: To investigate the effect of intra-fractional tumor motion on the dosimetric accuracy of the helical TomoTherapy for the treatment of hypofractionated lung radiotherapy cases using the TomoTherapy Hi-Art System.

Methods and Materials: A movable phantom system was developed with the TomoPhantom, motor/gear set, and remote-speed controller to find the impact of the breathing tumor motion or dosimetry. A pre-selected phantom case, which simulated a case of hypo-fractionated lung Image Guided-Intensity Modulated Radiosurgery was used to investigate the intra-fractional tumor motion. The phantom was moved in the superior-inferior direction with the displacement distances of no-movement, 1.5cm, and 3cm. Four different breathing cycle patterns (i.e., no-movement, 3sec, 5sec, and 8sec) were used to perform measurements. The dosimetric accuracy of a clinical DQA plan was analyzed using EDR2 film and A1SL ion chamber imbedded inside the phantom.

Results: Ion chamber measurements for the four different breathing cases were within ± 2% tolerance range compared to the no-movement case. For the longitudinal dose profile, the dose coverage for the tumor decreased as the speed of cycling increased from no-movement to 3sec. For the 3cm displacement distance case, the Full Width at 80% and 90% Maximum for the 3-second cycle case were reduced by 13~24% approximately ±3~6mm compared to the no-movement case due to breathing. However, breathing motion model here did not play an important role in the Full Width at Half Maximum. For the 1.5cm displacement distance case, the Full Width at 80% Maximum for the 3-second cycle case was reduced by 5% (2.6mm) compared to the no-movement. No hot/cold spots in the treatment region were found.

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Conclusions: Based on this preliminary study, it appears that in order to maintain dosimetric accuracy, a minimal 6mm clinical setup margin was necessary to account for the lung motion in the longitudinal direction.