AbstractID: 6800 Title: One Vision of the Next Generation of Helical Tomotherapy

Purpose: The current Hi-Art™ helical TomoTherapy system is dynamic in the following sense: the gantry and couch move at constant speed during treatment. However, the dose calculations approximate this motion with 51 discrete angles projected with constant pitch. The couch speed and jaws remain fixed during treatment, but if their dynamics could be made to vary within a fraction, then real time organ motion corrections would be possible. We estimate the benefits that could be obtained with these enhanced dynamics.

Method and Materials: Three key studies manifest the road to an enhanced TomoTherapy system. The studies are based on computer simulations. The first study explores longitudinal dose delivery resolution with the TomoTherapy system on a lung tumor with large avoidance structure adjacent superior and inferior. In the second study, an MTF-like or Delivery Transfer Function (DTF) approach is used to determine the constant gantry source motion blurring on the off-axis delivery – this effect has yet to be included in the treatment planning. Finally, the effects of longitudinal intra-fractional organ motion are explored with respect to typical delivery patterns.

Results: Equal importance specified adjacent to a tumor longitudinally can lead to few percent Gibbs-like inhomogeneities. Ideally, we should use multiple jaw settings at edges. The DTF estimate of the gantry motion dose blurring is that the 6.25mm MLC projection at isocenter can double for full intensity of that leaf 15cm off axis. For typical treatment parameters, intra-fraction organ motion leads to blurring of (motion amplitude)+(jaw width). If the couch speed and jaws could be variable within a fraction, then this blurring could be greatly reduced.

Conclusion: If the couch and jaws are made dynamic, and motion is incorporated into the treatment planning, then very effective control of intra-fraction organ motion and longitudinal resolution control would be achieved.