Purpose: In the context of lung tumor TomoTherapy treatments including a boost region based on a PET scan distribution, the clinical impact of neglecting intra-fraction motion during dose computation was evaluated with 4D Monte Carlo (MC) simulations.

Methods: The study includes ten lung tumor patients including a boost region defined using PET data and treated simultaneously with the remaining of the target volume (simultaneous integrated boost (SIB)) and planned according to the guidelines of ICRU Report 83. In this communication, we focus on one patient and vary temporal parameters to evaluate the potential effect of intra-fraction motion interplay with sliding jaw and leaf motions. The 4D-CT scan was acquired and temporally distributed over ten phases according to a breathing signal delivered by a motion detector, providing also an estimation of the breathing period.

Dose was computed with the MC model TomoPen. For every projection, simulations were performed on a CT phase selected according to breathing period and initial phase. The 10 dose maps were accumulated using non-rigid registration and then compared to the approved treatment plan. Parameters were varied as follows 1) variation of breathing period (from 3 to 8 sec) (motion interplay study) 2) variation in the initial phase (multiple fraction averaging effect) and 3) calculation with all the projections for every phase (only intra-fraction motion).

Results: Depending on the breathing period, all the simulations showed acceptable dose distributions on target volumes of the ten patients (0.3 to 1% for gEUDs of the boost tumor volume and the clinical target volume) indicating potential but minimal interplay effect.

Conclusions: For the patients studied, assuming regular breathing, the results showed that SIB treatments for a lung tumor with TomoTherapy including intra-fraction motion delivered acceptable dose distributions. This ongoing study will be extended to more patients, including hypo-fractionated stereotactic treatments.

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