AbstractID: 6679 Title: Dosimetric evaluation of MIP-based patient aperture and compensator designs to treat lung cancer using proton therapy under free breathing conditions

Purpose: Most proton therapy beam delivery systems still use passive scattering and design patient apertures and compensators under the assumption of static anatomy. Treatment of moving tumors is typically avoided. We investigated the potential of proton therapy to treat lung tumors under free breathing conditions via a MIP-based design of the aperture and compensator. Dosimetric effect evaluation of this approach was compared to two other strategies based on patient-specific Internal Target Volumes (ITVs). **Method and Materials:** A ten phase 4DCT treatment planning study was performed for a 3-field treatment of a lung patient. GTVs and normal tissue structures were delineated on 4DCT images. MIP images were generated by reassigning each pixel value to the maximum pixel value encountered in all 10 phases. Three sets of treatment plans were generated: Plan $ITV_{EOI,}$ Plan $ITV_{MOE,}$ and Plan $ICTV_{MIP}$ using the correspondingly designed patient aperture and compensator. Patient aperture and compensator were respectively optimized to ITVs derived from end-of-inhale or mid-of-exhale with 3D motion margins, or internal clinical tumor volume (ICTV) derived from MIP images. DVHs were calculated on ten phases using the same beam, aperture and compensator parameters to verify target dose coverage and dose to normal tissue following a prescribed dose 72Gy to the tumor. **Results:** Plan $ICTV_{MIP}$ assured the dose to 99% of the CTV (D_{99}) through ten phases (AVG=97.40%, MIN=96.40%, SD=0.5), compared to the results from Plan ITV_{EOI} (AVG= 71.00%, MIN =37.60%, SD=18.9) and Plan ITV_{MOE} (AVG=94.70%, MIN=83.50%, SD=4.0). The average mean lung dose for each strategy was 14.60Gy (Plan $ICTV_{MIP}$), 14.70Gy (Plan ITV_{MOE}), and 15.20Gy (Plan ITV_{EOI}). **Conclusion:** The MIP-based patient aperture and compensator design provides superior tumor coverage and similar dose or lower dose to normal lung tissue compared to the designs based on ITVs derived from end-of-inhale or mid-of-exhale with 3D motion margins calculated from 4DCT.