Purpose: To evaluate the dosimetric difference between helical tomotherapy (HT) and intensity modulated proton therapy (IMPT) treatment for lung cancer patients.

Methods: Five patients treated by HT at University of Wisconsin Carbone Cancer Center were selected. HT plans were generated on TomoTherapy treatment planning station (TomoTherapy Inc., USA). The field widths were set to 2.5 cm for all patients in this study. The IMPT plans were generated using the same planning CT and contours with our in-house treatment planning system. Three to five field spot scanning IMPT were used to deliver uniform doses to the targets while minimizing the irradiated lung volume. The proton spots used has a Gaussian sigma of 6mm and are placed on a rectangular grid. The dose distribution of each proton spot is calculated using a pencil beam algorithm with tissue heterogeneity corrections. All the dosimetric analyses are performed using normalized total dose. Alpha/beta ratios were set to 3 for normal tissues and 10 for tumors.

Results: IMPT plans showed improvement of critical structure avoidance and target dose uniformity for all patients. Reductions in mean lung doses of between 81% to 27% were observed in the IMPT plans relative to the HT. The equivalent uniform dose of the target improved from 49.2 Gy in HT plan to 60.04 Gy in IMPT for patient #2, and equivalent for other cases. The maximum doses to cord were reduced by 20.5 Gy on average using IMPT. In two patient cases, the normal tissue complication probabilities were reduced by 53% and 14% with IMPT.

Conclusion: IMPT provides improved dose homogeneity on the target and normal structure sparing compared with HT in the treatment of non-small cell carcinoma in lung. Significant reduction of mean lung dose was demonstrated, as well as toxicity to organs at risk adjacent to the target.