Purpose: Simplicity in treatment is preferable, whenever possible: it reduces errors, execution time and effort, and increases patient confidence. We aim at this benefit by using a natural body compression approach through positioning the patient prone, instead of the habitual (albeit unsubstantiated) supine positioning. The innovative premise tested in this work is that prone positioning can moderate the respiratory-induced motion and make it more consistent from cycle-to-cycle, compared to supine positioning.
Methods: Breathing traces from 8 patients positioned supine, then prone, were used to evaluate cycle-to-cycle variances in end-of-exhale(EoE), end-of-inhale(EoI) and average(AVE) locations, and to quantify the statistical significance at a p-value=0.05. Population variances were also evaluated for these locations.
Results: Prone positioning has improved EoE-location consistency for all patients, and was superior in all but one case for AVE-location. EoI reproducibility was poorer (improved in 5 out of 8 cases). Data analysis for the entire population reveals an overall improvement through prone positioning for all locations of interest. Variance reduction implies a corresponding reduction in the random component of the respiratory motion.
Conclusions: Our analysis demonstrates statistically significant improvements in breathing pattern consistency in prone position. This conclusion can be extended to the tumor motion as well, under the assumption that the RPM traces and the tumor trajectories exhibit similar motion pattern characteristics, a condition often fulfilled. Radiotherapy with prone body positioning is straightforward and non-invasive, and can be implemented without using complex respiration control technology (therefore could become widespread available). The reduction in breathing variability through prone positioning offers the potential for 4DCT image acquisition with even fewer motion artifacts and for radiation delivery under anatomical conditions resembling more closely those from the pre-treatment CT scans, while enabling the possibility of tumor dose escalation at similar or reduced normal tissue doses compared to the conventional supine treatment position.