AbstractID: 6757 Title: An analysis of the time delay and relationship between external sensor signals and internal organ motion for respiratory gated radiotherapy

Purpose: To estimate the delay time and relationship between external signals and internal organ motion for respiratory gated radiotherapy

Methods and Materials: In 5 patients**,** we measured the external respiratory sensor signals, which included respiratory volume, respiratory temperature, and abdominal displacement with three sensors (spirometry, belt-transducer, and thermistor), and internal organ motion with the fluoroscopy. To evaluate the relationship of the internal organ and external sensor signals, a linear least-square fit was performed with two signals, and the correlation coefficient (R values) was determined. In order to test the presence of a time-varying phase relationship, a unique cross-correlation of the respiratory motion signals and internal organ motion data were performed. Cross-correlation function (CCF) analysis allows for the identification and estimation of a phase or time delay in two related signals.

Results: The correlation coefficient of respiratory signal showed that the internal organ motion to abdominal displacement by piezo respiratory belt-transducer exhibited high correlation of 0.94 (range 0.98-0.85) with a standard deviation of about 0.06, whereas the respiratory volume and temperature to organ motion was a poor correlation (average 0.70, 0.71). The result of respiratory volume and temperature shows the influence of the phase shift, regarding time delay of 0.2 - 0.4 s. Two sensor signals considered the time delay correction generally correlated well with internal organ motion.

Conclusion: This correlation in this study can be used to predict internal organ motion, based on the external sensor signals. If the time delay of external sensor signals was corrected carefully, the use of the respiratory sensor would improve the accuracy for respiratory gated radiotherapy. Thus, it is expected that the respiratory sensors will come into wider use.