

**Purpose:** In order to develop radiation treatment planning based on a displacement probability function for lung tumors we developed a dynamic MRI protocol to image the internal human respiratory lung motion during a several minute period that simulates the duration of a radiation treatment, evaluated the long time displacement probability distribution function (PDF) of pulmonary vessels as surrogate tumors, and assessed its reproducibility with repeat imaging.

**Methods and Materials:** TrueFISP (fast imaging with steady-state precession) sequence was adapted to acquire real time MR images of human lungs during 5 minute scans in both sagittal and coronal planes. A total of 26 pulmonary vessels from different regions (upper, middle and lower) in 3 healthy subjects were examined. Motion profile and displacement PDF of each tracked pulmonary vessel were evaluated. Experiments were repeated after 2-3 weeks to test the reproducibility.

**Results:** Motion profiles and displacement PDF of the same subject showed similarity, but great variation between different subjects. Displacement PDFs varied tremendously but tended to stabilize during the 5-minute scan, and were reproduced reasonably well to various degrees in the repeated experiments after a subject specific stabilizing time (270s, 120s, 200s for Subject 1, 2, 3 respectively).

**Conclusions:** Experiments for the first time using ultra-fast real time MRI in extended time scans produce stable and reproducible displacement PDF of internal pulmonary structures, weakly depending upon different individual breathing patterns. This methodology is being investigated in a clinical trial at our institution to determine in a larger scale whether the reproducibility of motion is statistically significant and whether patients with lung tumor exhibit similar predictable breathing characteristics.