AbstractID: 3594 Title: Technical evaluation of respiration monitoring devices and breathing training techniques

Purpose: To compare external respiration monitoring devices and breathing training techniques for use in gated imaging and radiotherapy.

Method and Materials: Respiration was monitored on four humans with three devices: a spirometer, a pressure gauge inside an adjustable belt, and an infrared marker tracking system. Monitoring was performed under free breathing, with audible instruction, with visual instruction, and with both audible and visual instruction. Each test was executed for two minutes. Belt placement was tested on both the chest and abdomen, while marker placement was on the abdomen alone. Period and amplitude variability was analyzed on all traces to determine optimal belt placement and instruction technique. Individual cycle periods were compared between the three devices to test their correlation.

Results: Abdominal belt placement was optimal in all aspects. The uncertainty in periodicity with all devices was 4.6%, 15.3%, 18.6%, and 16.7% for free breathing, visual instruction, audible instruction, and both instruction techniques, respectively. The most consistent relative amplitudes were found using both instruction techniques. Significant drift in amplitude was observed under free breathing conditions. Comparison of individual cycle periods showed that the pressure gauge and infrared marker systems agreed on average within 10 ms, while the spirometer data differed from the others by 60 ms on average.

Conclusions: If using a pressure gauge system, the belt should be placed around the patient's abdomen. The most consistent periodicity results from free breathing, while the most consistent amplitude results from visual and audible instruction. The differences in period measurement between the devices can be attributed to the differences in sampling interval, while the consistently larger difference found with the spirometric data most likely is due to the calculation of volume from measured flow.

This work is supported in part by Grant # 03-028-01-CCE from the American Cancer Society and Siemens Medical Solutions.