ESTRO
<div style="text-align:right">Abstract</div>

Title

Investigating the use of Microsoft KinectV2 to monitor a patient's breathing during Lung SBRT

Purpose or Objective

To determine whether a KinectV2 camera can be used to monitor the variation in breathing trace via chest surface motion during Lung SBRT treatments.

Materials and Methods

Ten lung SBRT patients were recruited to a study where breathing traces (at 4DCT and each of 3,5 or 8 treatment fractions) were acquired. At 4DCT and the 1st fraction a trace was acquired via 2 external imaging devices as surrogates for internal tumour motion: the Varian Respiratory Gating for Scanners (RGSC) system and Kinect V2 (attached to the Couch at CT and to a ceiling mount in the Linac room). A region of interest (LT or RT of the RGSC block) on the patients' chest surface was selected from the KinectV2 surface images. The average depth to this ROI was calculated and compared to the RGSC trace. For the remaining fractions only KinectV2 was employed.   Lung SBRT was delivered with a 2 Arc VMAT plan, and KinectV2 acquisitions performed for both Arcs. A mean breathing cycle was calculated from the whole trace acquired during the time to deliver each Arc. This was performed by identifying peaks in each trace, splitting into individual cycles and finally binning these into 10 phases.

Results

The absolute amplitude of the RGSC and KinectV2 traces are not directly comparable. The KinectV2 gives a line of sight depth map in the ROI as opposed to the Ant/Post motion perpendicular to couch given by the RGSC system. The KinectV2 signal exhibited low frequency variations as the couch moved into the bore at CT and as the gantry rotated on treatment most likely due to change in the infra—red signal reflecting off the moving equipment and onto the selected ROI. There was very good agreement in phase over all 10 patients with an average Pearson correlation coefficient for RGSC vs Kinect at 4DCT and 4DCBCT of 0.882±0.076 and 0.993±0.007 for the whole trace and mean breathing cycle respectively.

Pearson Coeff	P1		P2		P3		P4		P5		P6		P7		P8		P9		P10	
	4DCT	4DCBCT	4DCT	4DCBCT	4DCT	4DCBCT	4DCT	4DCBCT	4DCT	4DCBCT	4DCT	4DCBCT	4DCT	4DCBCT	4DCT	4DCBCT	4DCT	4DCBCT	4DCT	4DCBCT
Whole trace	0.970	0.949	0.939	0.726	n/a	0.809	0.985	0.947	0.870	0.868	0.924	0.894	0.786	0.840	0.895	0.865	0.753	n/a	0.977	0.8732
Mean trace	0.996	0.981	0.999	0.996	0.991	0.990	0.999	0.992	0.997	0.999	0.999	0.995	0.995	0.976	0.985	0.994	0.997	0.972	0.998	0.999

Table 1 Pearson Correlation Coefficients for RGSC vs KinectV2 at 4DCT and 4DCBCT.*RGSC or KinectV2 trace was corrupted.

It was possible to perform KinecV2 acquisitions at treatment for all 10 patients, with no impact to patients or treatment session time. A similar pattern of variability in breathing traces was observed through treatment of all 10 patients. For a single patient, Figure 1a shows the variability in 38 individual breathing cycles making up the entire trace acquired from Kinect V2 during delivery of fraction1 Arc1. The mean standard deviation across all phases was ± 2.4mm. Figure 1b shows the variability in the mean breathing cycle (eg Day1Arc1 is the mean cycle from Figure 1a) acquired during Arcs 1 and 2 across the 5 fractions for the same patient. The mean standard deviation across all phases was ± 0.7mm.
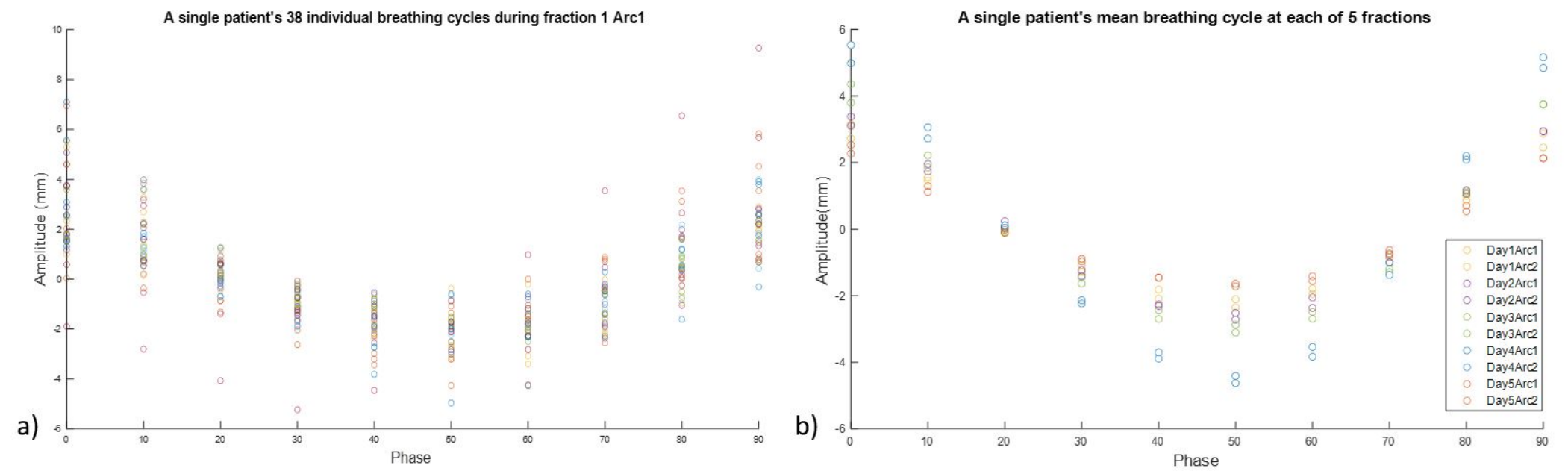

Figure 1 a) Breathing cycles during a single arc delivery b) Arc1 and Arc2 mean breathing cycle for 5 fractions.

Conclusion

There exists a strong correlation between traces obtained from the KinectV2 and RHSC system. KinectV2 can be used in a clinical setting to measure variability in chest surface motion through a patients lung SBRT treatment. Monitoring the trace will confidence the confidence required to reduce PTV margins by applying personalised margins to match variability due to breathing.